

SEP 10 1928

BRITISH ASSOCIATION NUMBER

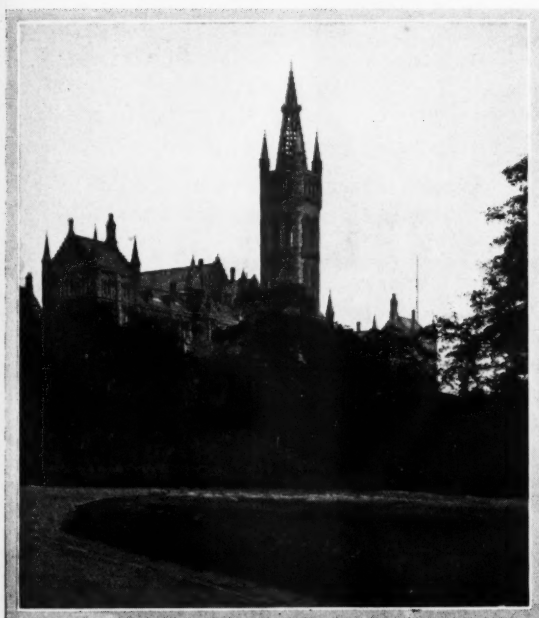
DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. IX. No. 105.

SEPTEMBER, 1928.

PRICE 1s. NET



THE UNIVERSITY OF GLASGOW.
Headquarters of the British Association Meeting.

CHIEF CONTENTS.

	PAGES
Editorial Notes	271
The Barges of Caligula... ..	273
The British Association... ..	276
How a Totalisator Works	278
Roman Antiquities in France... ..	282
Captain Cook	287
Rocket Flying in America	291
Correspondence	293
Ultra-Violet Aid to Growth	294
The Big Horn Sheep	297
Among the Stars... ..	298
Book Reviews	299

A PLACE AMONG MEN

By CAPT. GERALD LOWRY, F.R.G.S. (late Royal Irish Rifles), with foreword
by Field-Marshal Viscount Allenby, G.C.B. Half-tone and line illustrations.
Crown 8vo. 2s. net.

The author was the first British officer to be blinded in the war: the story of
his determination to regain "a place among men," at work and play, is inspiring.

MONDIALE, 18 ADAM STREET, LONDON, W.C.

INDEX TO ADVERTISEMENTS.

British Association Number, September, 1928.

	Page
Ajax, Ltd.	xcv
Allen & Unwin, Ltd., George	cv
Anglo-American Oil Co.... ..	xcvii
Baroux & Bion, Ltd.	xciii
Bedford College for Women	xcii
Benn, Ltd., Ernest	xcviii, cvi
British Association for the Advance- ment of Science	cii
Broadhurst & Clarkson	cviii
Brooklyn Botanic Garden, New York	c
Bobby & Co.	cviii
Booth Line	xcvi
Bowes & Bowes	cvi
Bumpus & Co., John	cii
Burroughs Wellcome & Co.	cviii
Cambridge University Press	ci
Canadian Pacific Railway Co.	ciii
"China Journal"	cvi
"Daily Telegraph"	xcviii
Davidson & Co., F.	cx
Dawson & Sons, William	cvii
Drane's	cvii
"Education"	cvi
Flatters & Garnett, Ltd.... ..	cviii
Foyle & Co., W. G.	ciii
Gallenkamp & Co., Ltd., A.	xciv
Johnson Matthey & Co., Ltd.	xcvi
Lewis & Co., Ltd., H. K.	cix
Linguaphone Institute	civ
Lippincott Co., J. B.	ci
London Provincial Corporation... ..	cix
Manchester College of Technology	cvii
Manchester, University of	cvi
Marlborough & Co., Ltd., E.	ci
Metropolitan Reporting Agency	cviii
Miscellaneous Announcements	cviii
Mondiale	xcv
Murby & Co., Thomas	ci
Newman & Guardia, Ltd.	xciv
Oertling, Ltd.	xcv
Open Court Co., Ltd.	cii
Pitman & Son, Sir Isaac... ..	cix
Putnam's Sons, Ltd., G. P.	xcix
Remington Typewriter Co., Ltd.	cix
Routledge & Sons, Ltd., George	xcix
Sands, Hunter & Co., Ltd.	cviii
Sinclair & Co., Ltd., J. A.	xciv
Thornton Butterworth, Ltd.	cv
University of Liverpool Press, Ltd.	c
Wase, Charles	xcii
Watkins & Doncaster, Ltd.	cviii

Bedford College for Women

(UNIVERSITY OF LONDON)

REGENT'S PARK, N.W.1

*For Resident and
Day Students*

Principal - Miss M. J. TUKE, M.A.

*Degree Courses in Arts and Science
Course of Training in Social Work*

SESSION 1928-1929 begins Thursday, October 4th
Prospectus free on application to the Registrar

OLIVE E. MONKHOUSE, *Secretary.*

The School of Practical Psychology

AEOLIAN HALL

NEW BOND STREET, W.1

Sunday afternoons at 3.15 p.m.

in OCTOBER and
NOVEMBER

Charles Wase, M.A., Ph.D.

will give a SERIES of

LECTURES

at the above Hall.

Subject:—

"The Coming Religious Revival"

Admission Free. Silver Collection.

Organ from 2.45 p.m.



DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. IX. No. 105. SEPTEMBER, 1928.

PRICE 1s. NET

Trustees: SIR J. J. THOMSON, O.M., F.R.S., SIR F. G. KENYON, K.C.B., F.B.A., PROFESSOR A. C. SEWARD, Sc.D., F.R.S., PROFESSOR R. S. CONWAY, Litt.D., F.B.A.

Edited by JOHN A. BENN.

Publishers: BENN BROTHERS, LTD. All communications respecting editorial matters to be addressed to the Editor; all questions of advertisements and subscriptions to the Manager.

Offices: Bouverie House, Fleet Street, London, E.C.4.

Telephone: City 0244 (10 lines).

Telegrams: Benbrolish Fleet.

Annual Subscription, 12s. 6d. post free anywhere in the world. Single numbers, 1s. net; postage 2d.

Binding cases, price 2s. 6d. net each; postage 6d. Complete bound volumes, 17s. 6d. net each; postage 1s.

Editorial Notes.

As we go to press the City of Glasgow is preparing to welcome the British Association, which holds its ninety-sixth annual meeting there from 5th-12th September. The sessions will take place in the spacious accommodation of the University, whose imposing buildings rival the ancient cathedral in reminding visitors of the historic connexions of Glasgow and its surroundings. Although the Clyde is most generally noted for its shipbuilding and engineering activities, which make it one of the foremost industrial centres in Britain, it was the scene of many famous events in Scottish history. Our article on another page dealing with the British Association programme mentions some of the excursions that will provide members with a glimpse of both these aspects of Glasgow. One of the impressions likely to strike those who are visiting the Clyde for the first time is the suddenness with which the industrially populated districts give way to gorgeous yet rugged scenery, an impression which emphasizes the hardy existence experienced along the west coast of Scotland. For several years past *Discovery* has published a British Association Number, not only for the interest of the considerable number of readers who are already members, but to provide a picture for the large majority unable to attend the meeting. Science has always been advanced by discoveries, and in that common bond we may express to the British Association our renewed good wishes for its continued progress.

Whatever may be the significance attaching to the boycott in City circles of the shares offered by a totalisator company floated in London last month, we believe the publication of an article on this invention will be welcomed. Major Ralph Glyn, M.P., our contributor, who introduced to Parliament the Racecourse Betting Act which has now received the Royal assent, is careful to avoid dealing with any particular make of machine, and he treats the subject purely from a technical point of view. While fully recognizing that the moral question involved by betting in any form is serious, and one which arouses heated controversy, the fact that *Discovery* is unable to entertain such discussion does not preclude the description of a betting invention in its columns. In explaining the workings of the totalisator certain remarks on existing betting practice are inevitable, for example, that the new machine provides a more equitable distribution of the proceeds; yet the most ardent opponent of gambling will desire a working knowledge of this device, if only that he may combat it more intelligently. We publish these remarks on Major Glyn's article not by way of apology, but to emphasize in advance that the editorial policy of *Discovery* provides only for the scientific discussion of such current problems.

* * * * *

Particularly in America, considerable attention has been attracted by the striking figures which Mr. H. J. Massingham advanced in his recent article on "The Close of the Age of Mammals." From a utilitarian standpoint—apart from what the author called "the sacred heritage of evolution"—the wide destruction that has marked the last fifty years is beginning to reflect itself in a scarcity of certain fur and skins, and some of the once plenteous sources of food are already on the decline. We therefore read with special interest an account of experiments with the buffalo in Canada, which has just been issued by the High Commissioner. Few chapters in the history of wild life conservation contain such a thrilling story. From the proud position of "lord of the plains" when it was numbered in millions, the buffalo was

brought to the verge of extinction. At one time the Indian tribes in western America practically subsisted on its meat, but this considerable destruction never equalled the annual increase of the herds. With the arrival of the white man, however, a disastrous inroad on the species began, and this had reached its limits when the Dominion Government first took steps twenty years ago. A further experiment was begun in 1925, and this year more than a thousand surplus animals have been removed from the National Park at Wainwright to a newer preserve in the North-west Territories known as Wood Buffalo Park. Similar progress is being achieved with the Big Horn sheep, and a Canadian contributor sends us this month a picturesque account, with some photographs taken in the Rocky Mountains.

* * * * *

Dr. Roy Chapman Andrews, the leader of the American expedition in Mongolia, has discovered many unusual specimens during his latest journey. Ninety cases of fossils have been brought back to Peking, including quantities of stone implements, and ornaments such as necklaces made of fox teeth. It is reported that north of Kalgan the expedition discovered remains of dinosaurs which may be as much as eight million years old. Another important find was the huge mammoth head of a titanotherium hitherto known only on the American continent. Apparently it is a new variety, as the nasal features are distinct from the known types. Dr. Andrews travelled five thousand miles, and he encountered severe sandstorms throughout the journey.

* * * * *

We recommend for support the enterprising work of the International Educational Society, which has been formed for the purpose of exchanging by mechanical means the selected lectures of scholars of all nations. In the first instance gramophone records are being used to this end, and those already available include "Specimen passages from Latin authors—as a guide to correct pronunciation," by Professor R. S. Conway. A similar lecture on "Shakespearean Recital" is recorded by Sir Johnston Forbes-Robertson and Mr. Walter Ripman deals with "Good Speech." Apart from its value in exchanging knowledge between different countries, the gramophone for pronunciation purposes is only rivalled by the wireless. Incidentally, contrary to expectation, the newer means has given a considerable fillip to its predecessor, as we found a few weeks ago on visiting one of the largest British gramophone factories. The International Educational Society (189 Regent Street, W.1) is providing double-sided records at the uniform price of four shillings and

sixpence; the President is Mr. H. A. L. Fisher, and it is not in the accepted sense a commercial undertaking.

* * * * *

A new cinematograph invention, claimed to be as important as the introduction of Mr. George Eastman's first Kodak camera in 1888, was privately demonstrated last month in London. "Kodacolour," as it is called, enables motion pictures in natural colours to be taken with an ordinary amateur's machine, all that is necessary being to place a filter on the lens of the camera for use in conjunction with the special film. This filter is a transparent gelatine disc, divided into three sections representing the primary colours—red, green, and blue-violet—and as the light passes through the disc it becomes separated into its appropriate colour group. The film itself introduces a revolutionary element in photographic manufacture. The side opposite the sensitive emulsion is embossed with thousands of minute cylindrical lenses, invisible to the naked eye. The light rays, before impinging upon the emulsion, pass through these lenses, behind each of which three distinct microscopical black and white images are formed, one for each primary colour. A gelatine disc similar to that used on the camera is placed on the lens of the projecting apparatus, which produces a picture in natural colours on the screen. From the first demonstration afforded, we cannot endorse fully the Kodak company's claim that the picture was "perfect," for the greens in particular were inclined to be harsh. But the invention is undoubtedly epoch-making, and as it will not be available to the British public until next year, there is plenty of time for improvement meanwhile.

* * * * *

A new record in deep-sea diving was achieved last month by Italian divers, who are now working off the coast of Brittany in an attempt to salvage the Belgian steamer "Elizabethville." This was sunk by a German submarine in 1917, and contained jewels and precious stones valued at over a million pounds. The apparatus used is made by the firm of Sorima, and the results so far achieved, according to *The Times*, make it possible to say that the major problem of deep-water salvage has been solved. Previously not a rivet from a wreck has ever been brought out by a diver at forty fathoms, but at Belle Ile, on 5th August, two divers in eight hours sent to the surface from that depth about twelve tons of material. All the gear worked perfectly throughout the day, and neither diver showed sign of distress or fatigue. We hope that the same success will accompany the efforts of the other Italian engineers who are working by different methods on the famous barges of Caligula.

SOME
of N
of D
water
disco
which
is a
disco

Fi
whos
in fie
Alber
to be
let d
them
hook
surpr
by th
avail
of ti
years

A l
milita
desce
Lorra
thoug
exciti
throu
acted
stran
when
"fish
mice.
The l
in the
ships

Th
fanta
forth
atten
Fusco
cerem
and r

Raising the Barges of Caligula.

By Daphne Shelmerdine.

Italian engineers are now in process of draining the Lake of Nemi, in order to raise the famous sunken barges of the Emperor Caligula. The author recently visited the lake and describes the proposed operations.

SOME eighteen miles south-east of Rome lies the Lake of Nemi, which was called by the ancients the Mirror of Diana. This year the lake is being drained of its water by means of electric pumps, in an attempt to discover the two great barges of the Emperor Caligula which lie sunk at the bottom. The history of the lake is a strange one, and this is not the first attempt to discover its hidden treasures.

The First Attempt.

Five hundred years ago Cardinal Prospero Colonna, whose family held the villages of Nemi and Genzano in fief, obtained the help of the engineer Leone Battista Alberti in a similar enterprise. Alberti caused a raft to be made, upon which he erected machinery, and let down into the lake great chains with hooks upon them. Seamen from Genoa were hired to fasten the hooks round the prow of one of the ships. They surprised the peasant inhabitants of the lake villages by their fish-like agility, but their diving was of no avail, for the chains broke, bringing only fragments of timber to the surface. This was between the years 1431 and 1439.

A hundred years later, on 5th July, 1535, the famous military engineer, Francesco de Marchi, made a descent in a diving bell, invented by Guillaume de Lorraine; but the attempt again ended in failure, though de Marchi's account of his expedition was exciting enough. The convex glass of the aperture through which he spied into the bowels of the lake acted as a lens, by which he saw fabulous sights; more strange than Edgar's imagined view from the cliff top, when he saw crows "scarce as gross as beetles" and "fishermen that walked upon the beach appeared like mice." De Marchi's vision was an inverted one. The lens magnified what he saw: tiny fish swimming in the water appeared monstrous beasts, and the great ships themselves he reported to be 475 feet in length.

They were, indeed, of an enormous size, but not so fantastic as this. An accurate description was not forthcoming until last century, when two further attempts were made. The first, that of Annesio Fusconi in 1827, was inaugurated with a great ceremony, to which were invited prelates, diplomats, and noblemen to witness the beginning of operations.

But this fine company which gathered about the desolate lake on platforms constructed for the spectacle saw no secret wrested from the silent water. It was not until the end of the century, in 1895, that a more definite account was given of the size and grandeur of the lost barges. By means of floaters attached by strings to the ship, Eliseo Borghi then outlined the form of a great barge upon the surface of the lake, while divers brought up mooring rings of great beauty and huge timbers were dragged above the water.

The first ship is about 200 feet long; the length of the second is probably more than 250 feet. Their depth is unknown, for their long burial has silted them up with sand. Their parapets are gilded, the decks paved with porphyry; bronze heads of lions and wolves, fashioned with exquisite workmanship, hold the mooring rings in their mouths, and fountains once played amidships. On the lead pipes Caligula's name is inscribed.

Unknown Purpose.

For what purpose were these enormous vessels, at least forty feet longer than the men-of-war of their day, launched upon a tiny lake which measures only four miles in circumference? Were they floating palaces, the property of Caligula, sunk by some catastrophe, or were they abandoned as Julius Caesar's large and costly villa on the shores of the lake was abandoned, because it was not to his liking? Or had they some connexion with that other and deeper mystery of Nemi, the sanctuary of Diana?

On the northern shore of the lake is a flat piece of ground called Il Giardino. Here, overgrown with bushes and thick grass, are the remains of a huge wall, some 700 feet long and 30 feet high, which forms two sides of a square on the north and east. In it are cut niches like chapels, filled now with trees and tall grass. The terrace it encloses rested, on the lake side, on a buttressed wall which was once probably lapped by the water. Upon this terrace stood the temple of Diana, thirty metres long and about half as broad. In its north-east corner a circular basement has been discovered which probably supported a vestal temple like the round temple of the Vestal Virgins in Rome. The terrace is now cultivated as a flower garden, and

sends daily to be sold at Rome the flowers for which Nemi is famous. In the spring it is a field of violas, stretching in a purple carpet from wall to wall. Such is the site of the famous sanctuary of Diana Nemorensis, which day and night was guarded by a priest whose successor slew him and was himself slain in his turn.

Conflicting Legends.

The foundation of the sanctuary is told in conflicting legends; its origin is lost beyond the reach of history, springing from remote and powerful beliefs in Diana, "the mistress of mountains and forests green, lonely glades and sounding rivers," of the chase, and of wild beasts and tame animals; the goddess of fertility and teeming life, who made the barren fruitful and conferred her blessing upon pregnant women. In those days the now desolate Campagna was thickly grown with trees, and the woods at Nemi were dark and sombre groves. Wild boars roved the primeval forest. On the summit of Monte Cavo, then known as Mons Albanus, rose the great temple of Jupiter Latialis. The neighbouring Latin cities looked with reverence towards the deep groves at Nemi, where the King of the Wood waited with drawn sword for his successor, guarding at once the goddess and his life.

The barbarous priesthood lasted into the times of the Antonines, when it was reported by a Greek traveller. While the long succession of Kings of the Wood fought and won, and fought again and died, the shrine of Diana increased in riches and splendour. Images of Egyptian goddesses, of Isis and Bubastis, were set up by Eastern potentates by the side of the statue of Diana the huntress, and of models of stags and hinds and the wild animals of her forests. So rich was the sanctuary that Octavian despoiled it of some of its treasures to fill his coffers. Tiles of gilt bronze roofed the temple, which was built of blocks of peperino with Doric columns. Diana was worshipped with fire and her great altars flamed beside the shore. On the 13th of August her annual festival was kept with sacred rites at every hearth in Italy; at Nemi a multitude of torches lit the dark grove, as the pilgrims processed to her shrine and besought the goddess for the fruitfulness of their lands, the blessing of their vines, the safe delivery of their children. This festival was later to be sanctified by the Christian church as the feast of the Assumption of the Blessed Virgin Mary, on August 15th, and to her also the people, changing their faith but not their desires, prayed for a blessing on the vines.

Perhaps the great barges of Caligula took some part in the Festival of the Ides of August, and while the procession of torches lit the grove, Caligula's ships

upon the lake, with their marble decks and playing fountains, shared in the worship of the goddess. But whether these ships were for the personal glory of the Emperor, which endured for four brief years before his end at the hands of his own servants, or whether they were dedicated to the glory of Diana, is so far unknown. Caligula, thinking that the King of the Wood had reigned long enough, hired a ruffian to provide him with a successor, and this appears to be his only known action in connexion with the sacred grove. It remains to be seen when the lake is drained whether the barges bear any signs of having been used in the service of Diana.

Never in the history of Nemi has such a fate befallen it as that which it will suffer this autumn. Hitherto divers have plunged into the lake, excavators turned up the earth, but the still, unmoving water has remained in the crater. All previous attempts at discovery have been directed towards raising the ships, and they have ended in failure because the barges are embedded in mud, and the timbers to which the chains were fastened broke away. The present century has brought new methods to the problem. It has been possible to observe the position of the barges from the air. From heights of which de Marchi did not dream when he went down into the lake in the diving bell, airmen have been able to look into its depth, and since the water will not give up its secret, it has been decided to remove the water.

An Ancient Emissary.

The Italian Government Commission which considered the problem last year suggested that Nemi should be connected with the neighbouring lake Albano by means of an underground tunnel. The blue Lake Albano, in which a palace of one of the Alban kings is said still to be buried, is more than 1,000 feet deep and lies at a lower level than Nemi, whose waters it could easily contain. This project was abandoned, because there already exists a channel through which the water can be drawn off, and the expense of creating a new outlet can thus be saved. An emissary, so ancient that the date of its construction is uncertain, though it is believed to have been constructed by Roman engineers in the second century A.D., drew off the water that might otherwise in rainy seasons have flooded the temple of Diana, which stood on a level with the lake, protected by the stone buttress. This emissary consists of a tunnel 1,649 yards long, running under the hill on which the village of Genzano stands—opposite the village of Nemi—to the plain of Ariccia, and thence to the sea. Five electrical and engineering firms have offered their services free of charge to the

Government to drain the lake until it is possible to see the prow of the first ship, which is not so deeply sunk as the second. From this point the Government and the archaeological authorities will be responsible for the continuation of the work. The pumping was to have been started in March, and it was hoped that the first ship would be visible in six months' time. Caution is necessary in draining the lake, as it is feared that the ships may be damaged if the water is withdrawn too rapidly. It was expected that the level of the water could be lowered by about one and a half metres for every thirty days pumping.

More recently, however, when the present writer revisited the lake, a small erection on the shore was the only sign of activity, and the construction of the funicular to carry equipment from Genzano to the water had not been started. The padrone of the inn at Genzano was busily enlarging his loggia in the hope of an increased number of visitors to Nemi to watch the operations. They will not see the mirror of Diana. The railway and the machinery set up in the midst of the crater will have most cruelly transformed her grove. But the engineers who are draining the lake have undertaken that the water shall be returned to the basin, and since this is composed of the hardest lava and basalt, and the water nowhere runs underneath the banks, there is no fear of a landslip which would alter the familiar shape of the lake and sweep away its gardens.

Nemi will be once more as it was, though, if the experiment is successful, it will no longer be possible to say that the Emperor's barges lie beneath its surface. Some more treasures will be added to the mooring rings which are to be seen at the Museo Nazionale at Rome. It is greatly to be hoped that an elaborate museum will not be erected at Nemi to



VIEW ABOVE THE LAKE OF NEMI.

hold the barges, for if it were decided that such a building necessitated a good road for visitors to the museum, sophistication would surely destroy what the centuries have preserved, and in the discovery of the barges something more precious would be lost.

We cannot escape the desire to look into the past.

"There is no immortality beneath the moon," but we needs must search the earth for memories of forgotten times, however vainly. If the impression of immortality rests anywhere in the soil, it rests here about the lake of Nemi. The woods are thinner than they were in the days of Caligula, the fields are lonely; no temples rise beside the lake, a mediaeval castle rears its walls in the village of Nemi; but the spirit of the watchful priest seems to brood over the scene, which in the freshness of the spring bears an indefinable imprint of



BRONZE HEAD FROM NEMI.

An early find from a ship in the lake, reproduced by permission from Carotti's "History of Art" (Duckworth).

antiquity, and needs no discoveries to bear witness to its long past. The secrets which we dimly discern the quiet earth knows and holds, and will yield them rather to the imagination than to the spade.

It is impossible to do justice to the beauty of Nemi, the loveliness of its desolation; the exquisite delicacy of the colouring of the woods; the grey-blue colour of the lake; the beauty of the flowers which follow each other in the rapid succession of the Italian spring—frail, early snowdrops, short-stemmed crocuses, opening starlike in the grass, violets, deep purple and pale parchment coloured, narcissi bending in the wind, and later sweet scented cyclamen. On the terraces of Il Giardino the heaped ranks of flowers are grown for the market, are plucked and plucked again, yet never seem to diminish; as though the goddess of fertility were still guarded by the melancholy priest, who now unhoused and deprived of his sombre grove, haunts in a milder spirit the solitary fields.



"DIANA'S MIRROR" FROM ANOTHER ASPECT.

The British Association for the Advancement of Science.

In publishing this month our British Association Number, as in previous years, we give some account of the principal items in the programme. Being held on the present occasion in Glasgow, the meeting provides both industrial and historical interests, of which details are included below.

WITHIN three years of attaining its centenary, the British Association meets this month, for the first time since the new distinction was conferred on its labours by the grant of a Royal Charter. In March last the King in Council approved this measure, a recognition especially fitting to a public-spirited body which experienced so many years of early struggle to establish its position in the popular confidence. As was recalled a few months ago, the term by which the Association is familiarly known—the “British Ass.”—was not in its origin the expression of warm affection it has now come to be, and even the leading newspapers joined at one time in the general ridicule.

The 1840 Meeting.

The meeting this year in Glasgow, from 5th to 12th September, harks back to the early days before education was general, and when certain members of the Association were already taking steps to widen the popular appeal of science. Particularly was this pioneer work undertaken among industrial workers, whose numbers in such centres as Glasgow readily provided large audiences. In 1840, the first occasion of the Association's meeting in Glasgow, Sir R. J. Murchison experienced a “glorious day at Arran when I lectured to a good band of workmen,”* while two years previously at Newcastle the famous geologist, the Rev. Adam Sedgwick, had addressed a similar gathering. These meetings took place before the introduction of the “public” lectures which are now a regular feature of the Association's programme. These lectures—not for members exclusively—are arranged on the present occasion both in Glasgow and its neighbouring towns, in co-operation with the Workers' Educational Association, which is associated with the Glasgow University Extra-mural Education Committee in the organization of public lectures and classes.

To-day, when these public facilities are so firmly established, and at a time when the relation of industry and science plays a prominent part in the Glasgow discussions, there is unusual historical interest—even

pathos—in the picture of this early occasion as described by Sir John Herschel.† A most brilliant meeting is over, he writes, which “Sedgwick wound up on Saturday with a burst of eloquence . . . of astonishing beauty and grandeur. But this, I am told, was nothing compared to an out-of-door speech, address, or lecture, which he read on the sea-beach at Tynemouth to some 3,000 or 4,000 colliers and rabble (mixed with a sprinkling of their employers), which has produced a sensation such as is not likely to die away for years. . . . It is impossible to conceive the sublimity of the scene, as he stood on the point of a rock a little raised, to which he rushed as if by a sudden impulse, and led them on from the scene around them to the wonders of the coal-country below them, thence to the economy of a coal-field, then to their relation with the coal-owners and capitalists, then to the great principles of morality and happiness, and at last to their relation to God, and their own future prospects.”

It can hardly be, to-day, that the British Association feels it necessary to apologise for its interest in practical affairs, yet perhaps in view of the diffidence still felt in certain academic circles an early note in the new programme introduces this connexion. It is pointed out that, keen as its concern for the advancement of science, the Association has never been unmindful or neglectful of the fruits of science reaped by civilization through industry and commerce, and that Glasgow, as among the foremost industrial towns in Britain, provides a fitting background.

Industrial Subjects.

Appropriately, several prominent members are following the President's lead in devoting their papers to the practical aspects of science. Sir William Bragg, K.B.E., F.R.S., will discuss in his Presidential Address the subject of “Craftsmanship and Science,” and he is expected to stress the relation of modern physics to national industrial problems. A similar topic has been chosen by Sir William Ellis, G.B.E., who as sectional president in Engineering will describe the “Influence of Engineering on Civilization.” In conjunction with members of the Educational Science

* See “The British Association: A Retrospect, 1831–1921.” By O. J. R. Howarth, O.B.E., M.A. (published by the Association), page 102.

† *Ibid*, page 101.

section, a discussion will follow on preliminary education for the engineering profession. In the Economic Science section, Professor Allyn Young's subject is "Increasing Returns and Economic Progress," while Professor T. H. Pear (Psychology) is to speak on "The Nature of Skill." The address will be discussed afterwards with particular reference to the present position of skill in industry, a matter in which the facilities of Glasgow should afford favourable assistance. Arrangements are made for members to visit various industrial works in the Clyde area, and to inspect at first hand some representative processes actually in operation. At Greenock, for example, the Royal Naval torpedo factory may be visited, and the Clyde valley electrical hydro-power station near Lanark and the Falls of Clyde is also scheduled.

Another aspect of the Association's programme, the history of Scotland, is arranged appropriately to a meeting in Glasgow. Although the city is more generally known for its industrial activities, in particular for shipbuilding, it is situated in a district rendered famous by the genius of romance, and still more renowned as the theatre of many thrilling events in Scottish history. Glasgow is also the seat of an ancient cathedral of great interest, which alike for its architecture and associations is one of the most important historical monuments in Scotland. The ancient university, too, is an imposing and elegant building, and the various meetings of the Association this month are to be held within its precincts.

Scottish Archaeology.

Sir George Macdonald, as its president, will speak on the "Archaeology of Scotland" to the Anthropology section, in which a discussion is also arranged on "Terrace Cultivation in Scotland." The address of general character which Professor J. L. Myres will give on "Ancient Geography in Modern Education" will be localized by a discussion, in the same section, on the teaching of geography in Scotland. Among the excursions of historical interest, provisionally arranged, are visits to Stirling, including the castle, the Wallace monument and Cambuskenneth Abbey; to Paisley Abbey and Coats' Memorial Church; and to Greenock, where the memorial to James Watt is situated. At Rothesay, besides the castle, and St. Blane's chapel, is the Bute national history museum, which contains the recent material from Dunstaffnage Fort and Cave.

In discussing the Glasgow programme, more especially for those who have not been able to study it in detail, it would give a false impression to suggest that its character is either mainly industrial or

historical. On the contrary, the usual wealth of subjects is offered to appeal to every taste. One of the most popular, for example, is likely to be Sir John Reith's lecture on "Wireless in the Service of Education," a new problem dealt with in *Discovery* by another official of the British Broadcasting Corporation, Mr. Edward Liveing, in his series of articles last spring. The variety of the programme is further indicated by the titles of the addresses of the sectional presidents. Incidentally, it may be recalled in this connexion that Glasgow is associated with the new practise of leaving sectional presidents free if they so desire to discuss their topics, instead of requiring a formal address to be read. For Sir A. C. Ramsay, who introduced this departure as president of the 1880 meeting, had given his first scientific paper at the Glasgow meeting forty years before.

The Sectional Addresses.

Besides the subjects already mentioned, the list this month includes: The Volta Effect—old and new evidence (Professor A. W. Porter, F.R.S.); Fluorescence, Phosphorescence, and Chemical Reaction (Professor E. C. C. Baly, F.R.S.); The Ancient Mountain Chains of Europe and America (E. B. Bailey, M.C.); Larval Forms, their Origin and Evolutional History (Professor W. Garstang); The Relation of Physiology to other Sciences (Professor C. Lovatt Evans, F.R.S.); Sex and Nutrition in the Fungi (Professor Dame Helen Gwynne-Vaughan); Next Steps in Education (Dr. Cyril Norwood); The Livestock Industry and its Development (Dr. J. S. Gordon).

On the recreational side of the meeting, the Lord Provost and Corporation of Glasgow will give a reception in the City Chambers. Many excursions also have been planned, and members are offered a choice of a dozen full-day outings on Saturday, 8th September. Among these, a sail may be made on the Firth of Clyde, including Kyles of Bute, round the Island of Arran, and Ailsa Craig; or, alternately, round the Lochs, through Kyles of Bute, and Loch Ridden, to Loch Gareloch. At Millport the Marine Biological Station will be inspected. There are also trips to the famous Trossachs, Loch Katrine and Loch Lomond, via Callander, and to Ayr, the Burns country and Mauchline. Last, but perhaps not least, a day is arranged at Gleneagles and at Turnberry for golfers!

During the meeting two evening discourses will be given as in previous years, the first by Professor Westermarck on "The Study of Popular Sayings," and the second, by Professor G. Donnan, F.R.S., on "The Mystery of Life."

The 1929 meeting will be held in South Africa.

The Totalisator and How it Works.

By Major Ralph Glyn, M.P.

Now that the Racecourse Betting Act has received the Royal assent, the bill having been introduced to Parliament by the author, it is appropriate that the invention known as the totalisator should be described in DISCOVERY. Technical considerations only are dealt with, the moral aspect of betting being a question outside the scope of this journal.

"TOTALISATOR" is an Australian word coined to describe the application of electricity to the old-fashioned "Pari-Mutuel" method of betting. The Pari-Mutuel system depended solely on human agency for its operation, and consequently there was always a danger of mistakes being made. In its simplest form the Pari-Mutuel consists of numbers in series, which are detached from a block in accordance with the number of unit bets invested on any particular horse, each horse having a separate series of numbers allotted to it. This method provides an automatic check on the total number of unit bets invested on the various runners. When the flag at the winning post fell the total number of units were added together, and in accordance with the investment made on each horse the odds were worked out, deducting the cost of operation and any taxes or charges due to the State and the racecourse company. The Pari-Mutuel can only operate in one place, and there must therefore be different pools in accordance with the number of Pari-Mutuel installations on different parts of the course. A five shilling unit is, for instance, more suited to the expensive enclosures, as is a shilling unit to the cheaper enclosures. There was therefore no uniformity, necessarily, in the odds paid out on a particular horse in one ring or another.

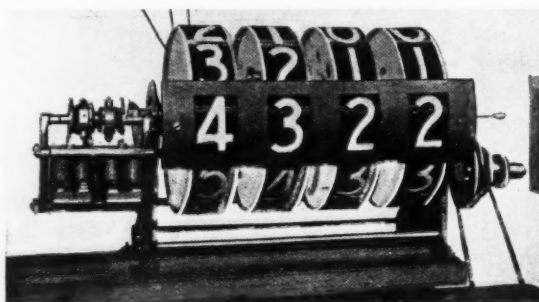
By the application of electricity it is possible to have a number of places in all parts of the course where betting can be transacted, and all having a common unit, say two shillings. Multiples of this unit can be arranged for, and the electrical machinery automatically creates a common pool of the total number of units staked, some being at face value and others in multiples of that unit. The totalisator system also guarantees the payment of winning bets,

and persons using the machine run no risk whatsoever of not obtaining their money. Since a known percentage of the takings of the totalisator will be deducted to meet the betting duty, the costs of operation and construction, and to provide a fund

for the benefit of racing, it follows that this system of wagering is really "co-operative betting." It enables the man who stakes his two shilling bet to obtain actually the same odds as the individual whose stake is five or twenty pounds as multiples of the unit. The poor man, in other words, will profit by the total amount of money invested by all persons using the machine from

different parts of the course, and may be certain that he will be paid out the actuarial and therefore the fair odds upon his selection, less the advertised and legal deduction.

There has been some doubt as to whether the cost of installing up-to-date machines is possible in this country on many racecourses, owing to the fact that race meetings are held on so few days in the year. To some extent this criticism is justified, but there are certain courses where it will undoubtedly pay to instal the necessary machinery and plant, to cater for the race-going public who use these courses in considerable numbers for certain well-known race meetings. For instance, at Newmarket, which is the only racecourse in this country owned by the Jockey Club, a rough estimate was made that the installation would cost £13,000 for the "Rowley Mile," and £7,000 for the "July Course." These figures do not include the cost of buildings: if plain but solid buildings, suitable for housing the machinery and providing the necessary number of betting "booths," were erected, the total cost for the two courses would be approximately £30,000. The similar costs on other



HORSE UNIT OF A SMALL TOTALISATOR.

The revolving drums are contained in the machine-room behind the indicator board, and only the figures giving the odds are exposed to exterior view. A unit of this type is required for each horse.

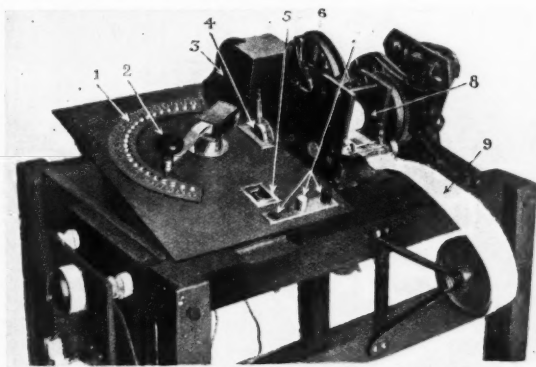
racecourses will vary in accordance with their size, the number of enclosures to be catered for, and the average number of persons who, it may be anticipated, will attend these meetings. Obviously, if racecourse authorities wish to take advantage of the construction of buildings to improve their stand accommodation, the cost will be proportionately greater.

A good method of lay-out places the central plant at a point between the paddock and back of the stands, and on this building the main indicator board is affixed. Repeater boards can be erected on the different parts of the course, and by electrical connexions instantaneously register the totals appearing on the main indicator board. Radiating out from the central building are buried cables to the ticket-issuing machines dotted about in the various enclosures, and also on the different floors of the stands. By this latter arrangement persons can make their bets without leaving the shelter of the stands. As a rule the pay-out counters are on the reverse side of the building where the ticket-issuing machines are located. Experience will prove what proportion of ticket-issuing machines will take wagers of the unit value itself, and how many machines there should be of twice, thrice, ten times, etc., the value of the unit.

The cost of each installation is to a large extent governed not only by these considerations, but by the maximum number of starters that might run in any particular race. It might be, for instance, that the average number of starters for a particular race on one day of the year far exceeds the average number of starters for any other race on any other day when a meeting is held. It would, however, be necessary either to provide indicator boards that would account for the largest possible number of starters, or else to limit the number of starters. Therefore the whole plant must be designed to suit the maximum requirements, although the machinery for certain races might only be used once or twice in the year. If the average number of starters on any course seldom exceeds fifteen, the total cost of the machinery can be worked out, but if on occasion there are up to thirty starters it would mean that the cost of the machinery, as distinct

from the buildings, would be just twice as much. This is a point which deserves very careful consideration, and must be a limiting factor in the use of the machine. If the Pari-Mutuel system is adopted it is not so strictly limited in its scope, because it is always possible to have extra series of numbers and additional places on the indicator board. With the electrical totalisator it means the actual duplication of the plant.

It will be recognized that until the Racecourse Betting Control Board is established it would be impossible for me to describe any particular machine, since the Board must have absolute freedom to decide which is the best machine for use in this country. There are, to my knowledge, a good many firms at present engaged in experimenting, and it would be a great mistake to assume that the British race-goer's psychology is comparable to that of race-goers in other countries. For instance, the British are accustomed to make their bets in accordance with the odds offered, and if a machine could be made which, instead of



TICKET-ISSUING MACHINE FOR TWENTY-FOUR HORSES.

The numbers in this photograph denote (1) Holes each corresponding to a horse, (2) selling handle, (3) opening for the printed ticket, (4) drum bearing numbers of the races, (5) counter registering number of tickets sold by the machine, (6) ejector of tickets, (7) switches controlling machine, (8) printing gear, and (9) paper ribbon.

registering the total number of bets, recorded what were the equivalent odds of that total number of bets on any particular horse, it is more than likely that such a machine would be best suited to British requirements. During the war a great many firms were engaged in the manufacture of very delicate electrical plant for use in the navy for fire control, when absolute accuracy and strength were essential requirements. I am personally satisfied that these firms will very soon be able to produce a machine that will offer big advantages over anything now in existence.

As *Discovery* is largely read by persons who have more mechanical and scientific minds than mine, I hesitate to give a detailed description of the method of the actual working of the electrical apparatus. It can, however, be stated that the following procedure will have to be common to all machines, whichever may be the type selected by the Control Board. The ticket-issuing machines will have to be capable of operating at high speed, and should any one of them break down the fact will have to be automatically notified to the central building, and

each machine must transmit an impulse to the central plant every time a ticket is issued to a person making a bet.

The totalisator cannot be responsible for the mistakes made by individuals who in error put their money on a horse that they did not intend to back. Also no ticket can be issued unless its full value in cash has been paid. The most modern form of ticket-issuing machine enables bets to be made for a win or a place by the simple operation of shifting the knob on the handle of the operator's lever. Electric contacts enable these different classes of bets to be registered with the central plant. By a simple arrangement situated in a specially constructed box, the turning of a lever cuts out all circuits and no further betting can be done the moment the flag falls. Whilst the race is being run the totals on each horse are calculated, and the moment the winning numbers are "up" and the "all right" signal given, successful backers

can obtain their dividends at the pay-out windows. It takes less than two minutes for the central totalisator office to register the proper amounts to be paid out on the winner and "place" horses.

As far as the central plant is concerned, each horse has a distinct set of machinery, and "place" betting requires a duplicate set of machinery of a similar character. Each "horse machine" is directly connected to the indicator that gives the public the total amount invested on all horses running in the race, which forms the pool. Since the number of bets on each horse is shown on a board, and in addition to these figures the total number of bets on all horses on a separate indicator, it is quite possible to know what are the odds at the moment against any horse. It is merely necessary to deduct the authorized percentage from the pool, then deduct the number of bets on the horse in question from what is left in the pool, and finally to divide the remainder by the number of bets on the horse, this giving the odds against the horse in question. It may sound

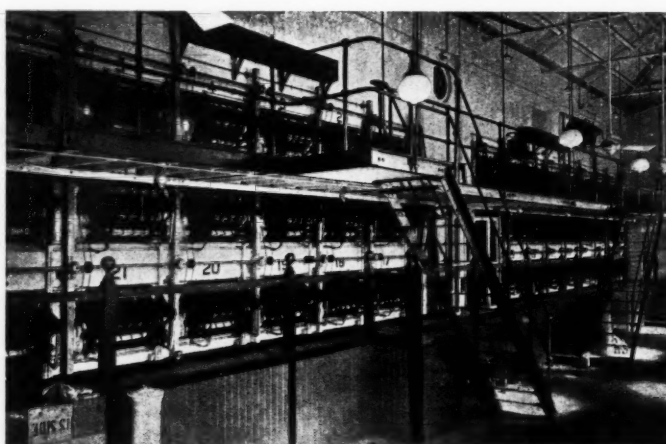
complicated, and as the numbers are constantly changing the exact odds against all the horses at any one moment can only be guessed. It is the practice on most foreign courses for a printed sheet to be issued every few minutes giving roughly the odds against the various horses.

If British inventive genius can produce a totalisator which does this calculation automatically and shows clearly to the public the odds against all the horses all the time, obviously that machine will be greatly superior to anything as yet in existence. Up to the present time the totalisator in general use in British

Dominions and foreign countries is Australian in its origin, and has been in use for a number of years, with entirely satisfactory results as regards accuracy, mechanical dependability, and ease of operation. It is advisable, if possible, to employ a highly trained staff to take charge of the ticket-issuing machines and to be responsible for accurate paying out.

The latter task is not as difficult as it might seem. The pay-out windows, as I have said, are on the opposite side to the ticket-issuing windows, and all payments are of similar amount, varying, of course, as regards the individual recipient with the number of tickets presented for payment.

In France and other countries a great deal of the racing takes place on a limited number of racecourses, and meetings are frequently held throughout the year. In England the practice has been to hold perhaps two or three meetings on the same day at widely separated racecourses. Some of these racecourses can always count on large attendances for the majority of the meetings, and on these courses an electrical totalisator will probably pay its way without difficulty. The problem, therefore, that confronts a racecourse is to consider whether or not the average attendance throughout the year will justify the expenditure involved in erecting these machines. From the point of view of the Racecourse Betting Control Board it will be of the greatest importance to devise some system



INTERIOR OF A TYPICAL MACHINE-ROOM.

This shows the interior arrangement of the board, on which the figure machines are placed in rows. The slots exposing the figures are seen in the photograph opposite.

whereby, if possible, the cost of these machines can be reduced, by transporting from one meeting to another as much of the machinery as is capable of movement. There is no reason why all the ticket-issuing machines, for instance, could not be moved from place to place. The main installation in the central building will have to be permanent, together with the various "horse machines" for win and "place" betting and their connexions to the total investment indicator. The buildings in which the ticket-issuing machines are placed should as a rule be of a permanent character, although in certain cases temporary buildings could be erected over the places where the cable connections emerge from the ground. This practice will undoubtedly save a good deal of expense, although my own opinion is that a great many racecourses will be content with the installation of the old-fashioned *Parimutuel* manual system, which costs very little to erect and is completely mobile in two or three lorries.

In any investigation of betting machinery it is always important to consider the problem of betting away from the course. This form of betting is a very large proportion of the whole volume. The practice to-day is for a large number of starting-price bookmakers or commission agents to have their offices in the larger towns all over the country. Our existing laws do not prevent these bookmakers to receive wires and telephone bets and also commissions sent by post, because the law by which the bettor may on no account "resort" to these offices for the purpose of making a cash transaction was on the Statute book before the invention of the telephone. In other words, credit betting is allowed, although it is certainly a pernicious form of gambling, and has been the cause of much of the trouble that comes from betting. The Street Betting Act has not been a success because quite illegally a large number of slips accompanied by cash reach these offices on a day when races are being held. The odds at which the bets are paid by

these starting-price bookmakers' offices are determined by the odds offered by the course bookmakers at the start of the race. Hence these odds have but little relation to bets received by the commission agent, and a considerable profit is usually assured to the various bookmakers through whose hands the transactions pass.

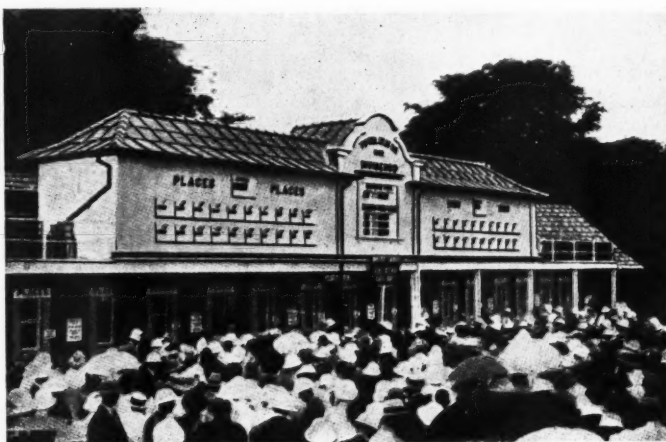
It is believed that when the totalisator is established the starting-price will be governed as a result of the public's use of the machine. The present official starting-price is settled by certain persons connected with the sporting Press who work out on the course

what the figure should be; on the whole they have done their work very fairly and honestly, but, of course, their decisions are not governed by means so accurate as the scientific betting provided by the totalisator.

The Racecourse Betting Act provides that the Betting Act of 1853, and certain other statutes, shall not apply to any racecourse that is

"approved" by the new statutory body known as the Racecourse Betting Control Board. It will be the business of the Board to make the condition of granting a certificate contingent upon the racecourse undertaking to observe certain rules of proper conduct.

Totalisators established on "approved" racecourses can only be used for betting on horse races that take place on these racecourses, and cannot be used for races taking place elsewhere. Furthermore, for the first time it is laid down in this Act that persons under seventeen years of age shall not use these betting machines. No limit has been laid down as to the amount that can be properly deducted from the pool, but about 8 per cent from the pool should be sufficient to meet the Government tax, and to provide the necessary funds to repay in time the cost of constructing and erecting the machines and for their operation. In addition the funds will be used at the discretion of the Racecourse Betting Control Board for furthering the interests of racing, of horse breeding, and in certain cases applied for charitable purposes.



TOTALISATOR BUILDING AT COLOMBO, CEYLON.

Here is seen the board which gives particulars of the horses and the odds offered by the totalisator. Each slot corresponds to a specific horse in the day's racing programme.

Roman Antiquities in Provence.

By R. Gordon George.

The final volumes have now been published in France of a series of studies on the Roman monuments undertaken by Professor Camille Jullian. In reviewing the recent work of French archaeologists, Mr. Gordon George traces in particular the influences which are reflected by the ancient remains in Provence.

It is the double business of the archaeologist to understand the excellence of antiquities and to use them as documents of history. A knowledge of Provence is part of a study of ancient periods, and part of a study of art. The world of culture, therefore, is indebted to those French savants who have been working in that field, and more indebted because they have been working admirably.

We owe a tribute to the archaeologists of France. It is now nearly two hundred years since Montfaucon produced his pioneering work on Roman remains. At the end of the eighteenth century scholars accompanied Napoleon to the Nile, and in their survey of Egyptian monuments opened up to Europe a new world of knowledge. It was again a Frenchman, Champollion, who was the first to decipher Egyptian hieroglyphics. Not many years later Botta excavated the great Assyrian palace whose monumental gateways and bas reliefs are now part of the Louvre collections. In elucidating the history and arts of Babylon and Elam, Frenchmen have done their share. Frenchmen, again, were in charge of the excavations at Delos and Delphi. Pottier, the keeper of Ceramics at the Louvre, is a name that accompanies the reputation of Pérot, Chippiez and Colignon. In the French colonies of Tunis and Algeria excavators have been busy. The gigantic Brahmin temples of Cambodia have been cleared from jungle. The great Salomon Reinach is himself a Frenchman; in our own time, also, Monsignor Duchesne, and a Belgian impregnated with French learning, M. Cumont, have each been supreme in separate fields of research in Rome.

The French have an exceptional stimulus in the fact that their own country has furnished remains which carry the story of man back from our own days into the dark night of time. Dolmens, menhirs, and caves

once containing objects from the neolithic age are to be found in the neighbourhood of Arles. And since Gallia Narbonensis was a Roman province, since Caesar conquered Gaul, France has a national interest in Roman monuments.



THE TRIUMPHAL ARCH AT ORANGE.

Orange was founded to wipe out the memory of a Roman defeat by the Gauls, and the arch illustrates Caesar's victories. One of the carvings shows a pair of trousers in token of contempt for the savages who wore them!

These have been the subject of a profound and brilliant study by Professor Camille Jullian of the Collège de France. The first two volumes appeared in 1906. The last two of eight were published in 1927, a study of the Emperors of Trèves. In his succession of crowded chapters, he builds up his immense and concentrated learning into a story so picturesque that we look clearly at the life of two thousand years ago. There the ancient settlements of Provence are seen in the multifarious activity of a busy and cultured people civilizing barbarians. Much of M. Jullian's work is original; here and there it is being supplemented by that of others, such as Commandant Espérandieu, the Abbé Sautel, and M. Benoit, the archivist of Arles. The work of the archaeologists may be traced in the proceedings of the Congrès Archéologique which has met, now at Vaison, now at Aix, now at Nice. Here and there it was prepared by the work of other savants. Not least of these is M. Michel Clerc, Professor of History in the University of Aix. His "Aquae Sextiae" appeared in 1916, following his earlier study of the campaign of Caius Marius in Provence. It traces the history of Aix to its obscure origins.

Livy was the most ancient authority on this subject. Flaccus, he said, who waged a campaign there in 125 B.C., first reduced the Transalpine Ligurians, when he was sent to the help of the Massilienses, whose territories were being ravaged by the Salluvian Gauls. Florus, writing two centuries later, expresses himself in vaguer terms, and the statement is repeated still more vaguely by other writers. Flaccus was succeeded in 124 B.C. by Sextius Calvinus, whom Strabo expressly

states
Diodo
It mu
speak
but a
for hi
which
the ob
hills o
await
the ch
the s
was t
again
Teuto
The m
the sl
and a
plain
could
three
this o
Calvin
spring
which
their
where
Natur
to wh
her ov
well
Roma
Apoll
of Aix
victor
the g
and s
their
tombs
was t
Of
incorp
eigh
clock
camp
rare,
Inscri
and I
and b
But t
the R
Arle
It ha

states to have been the founder of Aix, and to whom Diodorus Siculus refers, doubtless rightly, as a consul. It must have been his son or grandson of whom Cicero speaks as *ingenio et sermone eleganti*; and we cannot but admire the taste of the man who chose this spot for his settlement. In the broad and fruitful valley which lengthened on the road from Fréjus to Arles, the olive, grey-leaved and glittering, spread out among hills on which the vine and cypress and the villa were awaiting to be set out for man's delight, and to recall the charms of Attica or of the Campagna; above rose the summit of Mons Victoria which, from 102 B.C., was to record the great battle which Marius won against the Cimbri and Teutones on the plains below. The mistral was tempered by the slope of the northern hill, and across the rich roll of plain and rise, Marseilles could be reached in two or three hours on horseback. In this delightful spot Sextius Calvinus found one of those springs of medicinal water which the Romans, with their love of the bath, prized wherever they found them. Nature had prepared a spot to which history now points her own finger, and Aix was well suited to be the first Roman settlement in Gaul. Whether or not Sidonius Apollinaris, when he speaks in his odes of the trophies of Aix, was referring to anything more exact than the victory of Marius, certainly temples and statues of the gods were soon gathered in a place so attractive and so cherished. Equites and senators made Aix their home, and gradually it grew splendid with their tombs; not until the time of Augustus, however, was the settlement fortified.

Of this period few memorials remain. Many were incorporated into the old palace, but during the eighteenth century they too disappeared. The clock tower is undoubtedly the remains of a Roman campanile. Coins have been found, but, though rare, they cannot be called precisely informing. Inscriptions on stone, reliefs on terra cotta plaques, and Roman capitals are collected in the museum, and beautifully reproduced in Professor Clerc's book. But the other settlements are all much closer to the Rhone.

Arles was no doubt the most important of them. It had in those ages something of the success which

Marseilles has now, but it was important too as a centre of civilization, a centre where, as in Vienna and Budapest to-day, culture was enriched by the traffic of the orient with the west. It owed its first greatness to being sought out by Eastern traders. It is thought that the very name of the Rhone, Rhodanus, was due to traders from Rhodes.

The ancient settlement of Arles was established with rights and privileges as the centre of a Roman colony in 46 B.C. by Julius Caesar, who made it the headquarters of the sixth legion, giving it the name of Colonia Julia Paterna Arelate Sextanorum. The bull, which was Caesar's own emblem and that of the

sixth legion, was carved upon the monuments of Arles, which to this day brings its bulls from the Camargue to fight in the Arena. In the first century, it rose from the surrounding marshes with much of the eminence that to-day makes its walls and towers so striking from the hill of Montmajour. Built of stone, under the sign of the bull, the new city had the massiveness of Rome. No people in the zenith of its power built so much as the Romans.

Building was a passion with them, a manifestation of their force, a claim for everlasting permanence. And this, under the first emperors, was made in every colony. Grand and strong, their buildings are distinguished by massiveness, wealth and usefulness. Their architecture insists on vast materials. Its essence is the arch, as seen at Arles or elsewhere, in its bridges, aqueducts, gates, sewers, markets, theatres, baths, arenas, palaces and temples. Primitive but final, the arch is kindred to the dome of heaven which it mirrors, and human art can go no further than where sky and nature meet. No pointing spire nor Gothic soaring are more divine. This majesty was made the inheritance of Arles, and the order it implied gave unity to the style of the new city. Powerful corporations or *collegia* developed its old importance as a focus of traffic, and it became the wealthy emporium of the grains of Gaul.

Commerce and culture are sisters, and in the first century the citizens of Arles took an elevated pleasure in the things of the mind. From Greece, as we have seen, Arles took the fineness and purity of taste with which her statues, pictures, bas reliefs, altars, cups,



CLOISTERS OF ST. TROPHIME, ARLES.

The churches built in the early middle ages in Provence are often indistinguishable from the architectural work of the Romans, so much were their builders influenced by the classic style.

vases and candelabras were drawn and modelled. The harmony of lines which to the Greek became one of the very forms of thought (for he more than any other had the passion for beauty of lines and proportions), marks those fragments of triumphal arches which Arles still preserves in her museum and her Roman theatre. Greece gave to Arles her famous Aphrodite, now in the Louvre. It gave that head of Diana or Ceres, sculptured about the year 400, and described by Reinach as the "finest of ancient marbles discovered in Gaul." To Greek influence were due also the altars of the theatre, two with wreaths of oak leaves, one with a garland of laurel leaves held by swans. Arles thus, in the first century of our era, inherited from Greece the phases of art which Rome itself was to follow. Roughness, then grandeur, then grace, and at last voluptuousness have marked the rise and fall of most civilizations. In Hellenic art this was particularly clear. At the beginning when the influence of Aegina was supreme, it was hard, full of vigour, archaic. In the age of Phidias, it has nobility, severity, calm; and then a change is felt. A delicate sensuousness takes sharpness from the chisel; graces appear instead of majesty, and one feels that like the Pygmalion of the myth, the sculptor loves his Galatea not less than his art. As it leads on to the age of Praxiteles, Hellenic sculpture speaks more and more to the imagination and the senses. Arles knew of all these, but it treasured most the works of the age of Pericles.

Lovers of art, the great merchants of Arles had a link also with literature. Pliny the Elder made mocking references to Pompeius Paulinus as a *nouveau riche*, but his daughter married Seneca who dedicated to the old merchant the Treatise *De brevitate vitae*, and the virtues of the family are celebrated in the *Annals* of Tacitus. Among the sons of Arles, Clodius Quirinalis taught eloquence at Rome in the age of Claudius, and the philosopher Favorinus was the friend of Plutarch and Epictetus.

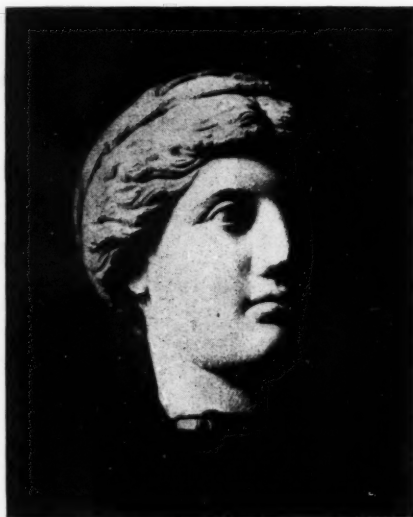
Fifteen or twenty miles across the river was Nîmes. "Strange and attractive city!" writes Jullian. "Its origin is mysterious, it draws from the past a subtle charm, and its life is difficult to realize." It was the

holiest of all the cities of Gaul; its sacred spring, *deus Nemausus*, issuing from one of its highest hills, now in peaceful eddies, now rushing in waves of foam, gave a constant sense of the presence of the gods, and nowhere did loyalty to the emperors take so easily the form of a religion. Therefore was a temple raised to survive to our own times as a memorial to the grandsons of Augustus, and the basilica was a memorial to Trajan and Plotina. The amphitheatre, though not so large as at Arles, is in better preservation.

A gate, still known as the *Porte d'Auguste*, survives also to our own time. Here arose the family of the Emperor Antoninus, whose spirit was that of Nîmes itself. It was dominated by a religious and dutiful middle class, devoted to family life and practical affairs, and this answers the ideal of the Antonines.

Not unsuitably, therefore, do we think first of its temples, of which one is far the finest survival of Roman temples anywhere. "The *Maison Carée* of Nîmes is a jewel," writes Professor Jullian, "with its dimensions so well proportioned, its component parts so well adjusted, with the fine colonnade which surrounds it without weakening its effect, with the broad portico through which the

light pours in waves, with its capitals of olive leaves, sculptured with a chisel delicate and sure. But in spite of all, when the eye lingers long, the final impression is cold and spiritless. And I recognize too well the meticulous measurement, the patient toil of a faultless pupil of the Greek masters. What perhaps give it most life and most attraction is the blue sky which at once surrounds and penetrates it, it is the patina, the gilded imprint which have been left upon it by twenty centuries of southern sun." It was just this excellence and this want which typified life as a whole under the Roman Emperors. We must beware of idealizing the life of either ancient Greece or ancient Rome, while admiring the beauty and appreciating the interest of the charming monuments of Provence. The two fine statues in the *Maison Carée*, one of a lady, one apparently of the goddess Ceres, are each more lifelike and individual than the head of Venus there, which is in fact a reproduction of the Venus in the Capitol. But as we look at these



SCULPTURED HEAD FROM VAISON.

The most beautiful Roman remains at Vaison are the statues in the local museum, of which the piece here illustrated, a woman's head crowned with laurel, is an example.

we see that, exquisite as was the feeling for line, and therefore for drapery, the face lacks animation. The fires of vitality refined to a spiritual strength are something ancient art rarely knew. It hardly moved aside the muddy vesture of mortality. It showed its fuller felicity in the proportions of architecture. And though it has not survived in the perfection of the *Maison Carée*, the temple in the gardens at Nîmes has a still greater charm in the proportions of its walls to one another and to the vault of its roof. Its niches with their entablatures above, alternately curving or pointed, are also beautifully set, and it is to be noticed that its slabs and the stones of its vaulting were so well cut that they had no need of cement.

A model of the *Maison Carée* survives, smaller and blacker, at Vienne. Vienne, city of the Allobroges, knew itself to be, and named itself, Celtic. It was the centre of a great realm, mistress of Grenoble and of Geneva. There the original inhabitants began to adopt the habits of the senators. Its luxury astonished the Romans themselves. When the generals of Vitellius arrived from Germany, they redeemed it from pillage, as Tacitus makes clear, at the cost of several million sesterces. Martial designated the town as beautiful and rejoices that books are its chief delight. Of the treasures of this epoch many are gone to Lyons, or the Louvre. A famous mosaic is in the gallery at Grenoble; but there are many fine bas reliefs, and a notable head in ivory. Among other curious remains at Vienne is an obelisk built on the square roof of a quadruple arch; this was raised in the ancient circus, as the obelisk at Arles makes the site of the stadium there.

But scattered through Provence are many remains of the Roman Empire. At Die, there are the remains of a Roman arch built into the mediaeval ramparts, and an altar for the sacrifice of bulls; at Carpentras there is a triumphal arch with reliefs of captives on either side; between Apt and Bonnieux there is a Roman bridge over the Calavon, but the statues from Apt are at Chatsworth; at Vernègues there are the remains of a small temple, attached probably to a neighbouring villa; at Cavaillon there are two arches,

one of which has two graceful winged and draped figures in low relief among the remains of one of the most delightful of conventional designs; at Saint-Rémy, a triumphal arch and a mausoleum make a delightful group among the trees. This arch has all the qualities which the age of Augustus gave to architectural style and ornamentation. Not only the harmony of the composition, but the carvings of oak apples, grapes, pear, pine-cones and pomegranates are charming: the mausoleum has four interesting

bas reliefs carved on the stylobate; on one side an engagement between horsemen; on another a fight round the body of a fallen warrior; on the third a combat beside a river which is symbolized by a river god; and on the fourth the hunting of a boar. These are well designed, and full of vivid incident. The remains of Saint-Rémy are built upon the ancient Glanum, where recent excavations have shown the remains of a Roman temple and have led to the discovery of an altar dedicated to Sylvanus.

There still remain the great monuments of Orange, Vaison, and the Pont-du-Gard. The Pont-du-Gard was part of the aqueduct designed to bring water from Uzès to Nîmes; of this aqueduct many divided portions have been traced. It was built probably at the command of Agrippa, the son-in-law of Augustus who was endowed with something approaching sovereign power; this power he exerted so as to leave a lasting civilization where government and private life would both be happy. The Pont-du-Gard is his great monument. Its three tiers raise it to the height of over 160 feet above the waters of the river.

At Orange, both arch and theatre are magnificent. No other Roman theatre, except that at Aspendos in Pamphylia, retains its high façade. This one rises to 135 feet, and gives back a clear echo, even to low tones, as to the cooing of the doves flying among its heights. In the central niche was placed the statue of the Emperor; and there are traces that show how thoroughly the architects understood the needs of both players and spectators. Apart from the excellent arrangements of acoustic, the wall gave shelter from the mistral, and huge awnings raised on masts gave



THE MAUSOLEUM AT SAINT-RÉMY.

With the adjoining triumphal arch, the mausoleum forms a delightful group among the trees. Recent excavations have shown here the site of a Roman temple. (Copyright photograph by M. Amiel, Aix-en-Provence.)

shade. Orange was founded by a colony of veterans of the second legion, stationed there, according to M. Jullian, to wipe out the memory of a defeat of the Romans by the Gauls. The arch is carved with scenes therefore of the victories of Caesar on land and sea, and among them are trophies and ensigns of the Gauls, including a pair of trousers, in token of contempt of the savages who wore them. *Tempora mutantur.*

The Vaison Museum.

Orange has long been famous, but Vaison, some thirty miles away to the east, may almost be called the discovery of our own generation. It has been the especial study of the Abbé Sautel, whose taste and judgment deepen his erudition. His book on the Roman cities in the Rhone valley is the best introduction possible to the ancient province, and the same high standard is maintained in M. Benoit's book on Arles. M. Sautel has now produced larger and more learned volumes on Vaison in which everything that bears upon the excavations there is set out with a clearness never sullied by his learning, though it is meticulous. At Vaison there is also a theatre, there are the remains of villas, of baths, and of an aqueduct. There is also a Roman bridge. But the most beautiful of its remains are the statues in its little museum. These are beyond comparison the best in Provence, even though the Roman replica of the famous Diadumenos of Polycleitus was acquired by the British Museum when it was discovered in 1893. But the head crowned with laurel in the ruins of the Roman houses is not unworthy of comparison with the head at Arles. The statues of Sabina, of Hadrian, of Tiberius, of the emperor in a cuirass, and not least the headless figure in a toga, attest sufficiently the taste and dignity of Vaison, which is designated by M. Jullian as the most elegant in the province, the one which tasted most of the luxuries of Roman government.

So thoroughly did the Church adopt the Roman monuments that the architectural work of the Romans is often indistinguishable from that of mediaeval Provençaux. One sees this at the Cathedral of Vaison, at St. Gabriel near Saint-Rémy, and in the Porte d'Orange at Carpentras. Two or three centuries ago, the temples at Nîmes were used as churches, and that of Livia at Vienne was known as Notre-Dame-de-la-Vie. Sometimes the wheel has gone round further, for the museum at Arles was built as a church. And even the great new churches of the early middle ages gained so much from the Roman survivals around them, that the portal of St. Trophime at Arles, and the far more glorious one at St. Gilles, surpass their rivals because

of their classic temper. It is a classic harmony likewise in the beautiful cloisters of Arles and Saint-Rémy, of Vaison and Montmajour. It was not unnatural that the Popes in exile should come to Avignon, and a building of Paul V in front of the Popes' palace give Provence a link with Rome's development of the classic revival in the sixteenth century. And it must not be forgotten that the Comtat Venaissin was a papal territory up to the French revolution.

In what form did the victorious religion come to Provence? Stubborn tradition traces it back to the personages of the Gospel; and it is clear that the people failed to distinguish between Caius Marius and the Maries, whether Madonna or Magdalen. An ancient legend pictures the Magdalen arriving with two other Maries and a St. Sarah, their Ethiopian servant, in a ship guided by winged angels to where now rises the fortified Church of the Saintes Maries, and the chapel of the Sainte Baume is venerated also as the home of St. Mary Magdalen. This touching veneration of the penitent sinner is less wonderful than the undeniable truth that the faith inspired in a few poor Jews by a discredited Teacher traversed the Roman Empire so rapidly that it spread in Provence in the same days as the Roman culture which, in the course of three centuries, it wedded with its own. Roman Provence is replete with Christian antiquities. The museum at Arles has the finest collection of Christian sarcophagi outside the Lateran; and the simple words *Pax eterna*, written upon one of them, had—will always have—a stronger hold over the human mind and heart than every memory perpetuated by the Romans in their greatness.

Pulverized Coal for Ships.

THE Glasgow correspondent of *The Times* reports that an important development in marine engineering, which should react favourably on the British coal industry, is to be introduced on the Clyde. In a cargo-carrying steamer of 8,000 tons deadweight which the Berwindmoor Steamship Company of Liverpool has ordered from the Blythwood Shipbuilding Company of Glasgow, pulverized coal will be used as fuel. It is stated that this will be the first ship built or owned in Britain in which this method of using coal will be introduced.

As the machinery and boilers will be of ordinary types, comparisons will be possible with existing installations regarding economy and efficiency. The raw coal will be carried in ordinary bunkers, and will be pulverized on board by a special plant.

The Bicentenary of Captain James Cook.

By R. N. Rudmose Brown, D.Sc.

Captain Cook's bicentenary is to be celebrated in Yorkshire on 8th September, but the profound importance of his geographical discoveries is not yet generally appreciated. Cook's long voyages were made possible by his methods for prevention of scurvy, at that time a universal disease among sailors.

THE great age of discoveries had ended before the close of the seventeenth century. In two centuries the search for the eastern and the western routes to the Far East had revealed many of the borderlands of the Pacific Ocean, but the ocean itself was little known. During the late seventeenth and early eighteenth centuries voyages of pirates and buccaneers did more than others to score this great blank on the map, but much of their work was vague and their reports were inconclusive. Trade was still the chief motive in exploration, but the age of geographical voyages as apart from purely economic ones was dawning when James Cook was born two hundred years ago, on 28th October, 1728, in the Yorkshire village of Marton, on the edge of the Cleveland Hills.

A Southern Continent.

One of the problems exercising the minds of cartographers, not to speak of traders, in the eighteenth century, was the existence of a Southern Continent. It was not a new problem. When the Greek astronomers conceived the world to be a sphere with Europe and Asia in the northern hemisphere, they postulated a southern continent for the sake of balance and symmetry. Alter Orbis of the ancients was the beginning of the mysterious Southern Continent that was sought for assiduously and hailed in many lands and unimportant islands from the sixteenth till the eighteenth centuries. Magellan, in his discovery of Tierra del Fuego in 1520, was the first to sight what might be part of a southern continent, but his discovery was regarded merely as confirmation of the great land, based solely on credulity, which appeared on such globes as those of Leonardo da Vinci and Schöner in 1515. Fuegia was not displaced from its position of fame until Drake in 1578 found it to be an island, and even then the significance of his discovery was overlooked. New Guinea, the Santa Cruz Islands, the Solomon Islands, New Holland (Australia), Espiritu Santo (the New Hebrides), Staten Island (New Zealand), Easter Island (if this was Davis Land, which is improbable), Bouvet Island (Cape Circumcision), Samoa, the Crozets, and Kerguelen; each at one time or another was hailed as the outpost

of the reputed Southern Continent, so great was the obsession of its existence.

By the third quarter of the eighteenth century the postulated continent had shrunk a little in size and faded slightly in reputation, but there was plenty of room on the globe, even in temperate latitudes, to contain it. It held out hopes of vast new trading grounds, and one estimate put its population at about fifty millions.

Alexander Dalrymple, who was Hydrographer for thirteen years after holding a similar post under The East India Company, published in 1767 a chart of the South Pacific showing discoveries previous to 1764, accompanied by a work in which he sought to prove his belief in a southern continent. The chart showed no land south of latitude 30°S. between South America and Van Diemen's Land except vague indications of land (which have since proved non-existent) west of the 90th meridian and the coast of Staten or Staat's Land in about 170°E. These lands suggested the edge of a continent. To the northward of this great empty space lay signs of land on Quiros' track (1606), Tasman's Rotterdam Island (Tonga group) found in 1643, and Roggeveen's track of 1722. In the Indian and Atlantic Oceans there were comparable blanks in even moderately low latitudes. Bouvet Island (Cape Circumcision, 1739), merely supported the belief in a continent, and it is doubtful if South Georgia had really been sighted at that date.

Dalrymple's Chart.

It is true that the modern charts show great areas of empty ocean in the same latitudes as Dalrymple did, but that is the outcome of knowledge; in his case it was the result of ignorance that allowed imagination full scope. The voyages of Byron, Wallis, Cartaret, and Bougainville in the same decade that saw the publication of Dalrymple's chart focussed attention more closely on the Pacific by the discovery of new islands and strange peoples, but did nothing to investigate the southern part of the ocean. The avoidance of the South Pacific was no doubt largely due to the necessity for a vessel bound westward

from the Straits of Magellan keeping well within the south-east trades and avoiding the westerly winds. The Magellan route was the obvious way both for South American trader and buccaneer, and the shortest way to the Pacific even if the East India Company had not held a virtual monopoly in the Cape route.

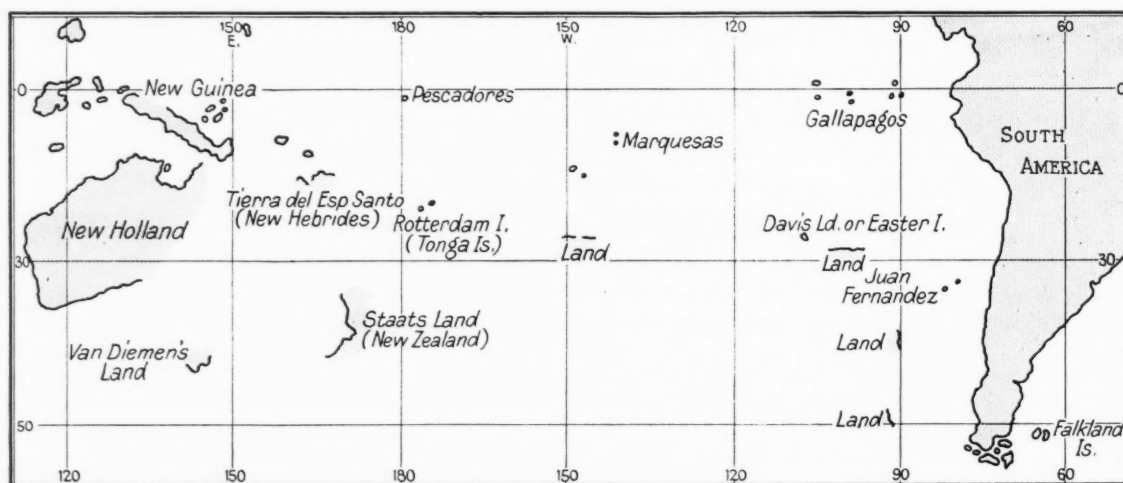
Royal Society Expedition.

When Cook was selected by the Admiralty to take command in 1768 of an expedition to the Pacific under the auspices of the Royal Society and the patronage of King George III, he had already made his mark as a careful surveyor in Newfoundland and the Gulf of St. Lawrence. He was then a lieutenant in the Royal Navy, having gained commissioned rank after several years in the merchant service, where he worked his way from deck-hand to master. He certainly had no influence behind him except what merit had earned him, for the son of a farm-labourer who had been a draper's assistant before he ran away to sea had no wealthy and powerful friends. The *Endeavour* was to take a party to Tahiti to observe the transit of Venus, and then turn southwards on a voyage of exploration. The results of this voyage were enough to establish Cook's reputation for all time. Tasman's Staten Land (or New Zealand) was proved to be an island group and to have no relation to a continent. Cook sailed round both the north and south islands and made an admirable chart of the coasts. Few stretches of coast were left blank in his 1,800 miles of survey, which occupied him six months, and with his usual truthfulness and lack of

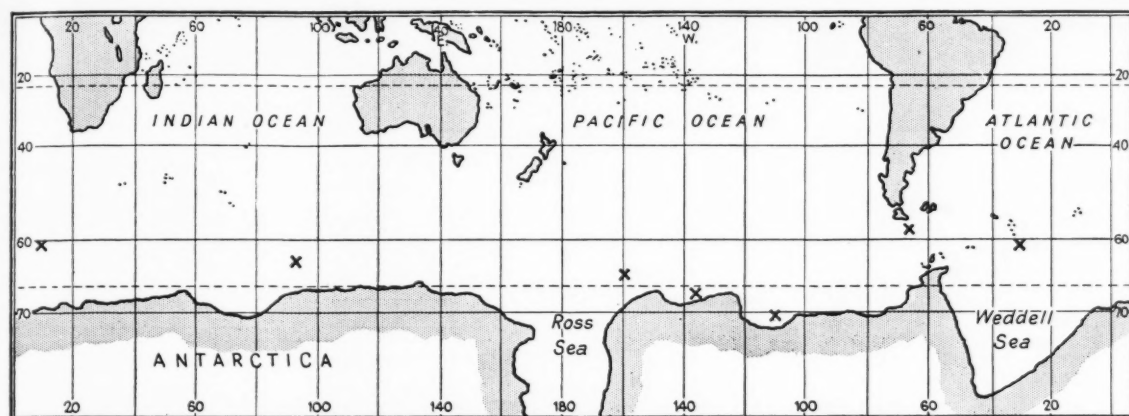
any boastful spirit, Cook noted "such places as are drawn with sufficient accuracy to be depended upon and such as are not."

Cook was then anxious to stand southward and make Cape Horn in a high latitude in order to settle the problem of a Southern Continent. But the state of his ship did not allow this and so he sailed east for New Holland, and was thus led to the achievement that among his many discoveries has had the greatest material result to his countrymen. From the neighbourhood of Cape Howe he sailed northward to Cape York, filling in the entire missing east coast of Australia, the one important coast that the earlier discoverers of New Holland had overlooked.

Two thousand miles in four months was no mean feat, and though it was done from a moving ship the completeness and accuracy of his charting were remarkable. The *Endeavour* carried no chronometer; the longitudes were found by lunar observations by Charles Green, the astronomer of the expedition. Cook gave this coast the name of New South Wales, though in one of the three copies of his log of the voyage the name New Wales is used. Before Cook's day Australia, known only from its less attractive coasts, was regarded as a worthless land. Cook's discovery of the well-watered east coast, though his account of the country was based on only four landings, led eventually to the colonization of Australia and incidentally to its passing to the British Crown. Then, after confirming the separation of New Guinea and Australia, for Torres' discovery of his strait was not appreciated at that time, Cook returned home *via*



SKETCH OF DALRYMPLE'S CHART OF THE SOUTHERN PACIFIC, 1764.
Showing the indications of land in the south (modern names added).



CAPTAIN COOK'S SEARCH FOR THE SOUTHERN CONTINENT

The crosses mark the furthest points to the south reached by Cook in his search for the Southern Continent. The outline of the continent is approximate.

the Cape of Good Hope. This was only the twentieth occasion on which the world had been circumnavigated, so that even from that standpoint the voyage was notable.

In his journal of this voyage Cook gave his views on the problem of a southern continent. His discovery of the insularity of New Zealand had curtailed its possible extent. From his own evidence, and his reading of that of Quiros and Roggeveen, he believed that no great land reached north of latitude 40°S. in the Pacific, but "what may lie to the southward of that latitude I know not." He thought it a pity "that this thing, which at times has been the Object of many Ages and Nations should not now be wholly clear'd up: which might very easily be done in one Voyage without either much trouble or danger or fear of Miscarrying, as the Navigator would know where to go to look for it." This was the main object of his second voyage when with the rank of Commander he sailed in 1772 with the *Resolution* and *Adventure*, two north-country colliers built like the *Endeavour* at Whitby. His orders were to "discover the Southern Continent or to disprove its existence"; if he found it, to explore as much as possible, "to make observations useful to commerce or the promotion of natural knowledge," and if he found inhabitants "to show them every kind of civility and regard."

The First Antarctic Voyage.

The voyage of the *Resolution* and *Adventure* (1772-1775) was the first and in some ways the greatest Antarctic expedition that ever sailed. A great part of Cook's course was in the stormiest seas in the world, where drifting ice and poor visibility add to the dangers encountered by a small sailing ship. And yet in the

range of his journeys and the persistent efforts to penetrate the pack-ice Cook has never been equalled. For his longitudes he again depended mainly on lunars, although the expedition carried four chronometers. Several determined attempts were made to push southward in widely different longitudes and the globe was circumnavigated in a high latitude. No Antarctic land was sighted, for by singular ill-chance Cook chose for his southern ventures places where subsequent knowledge has shown the pack-ice to be persistent. Several minor discoveries were made: the South Sandwich group, South Georgia (though this island may have been known previously), and New Caledonia. Cape Circumcision (Bouvet Island), which he failed to find by searching too far to the east, Cook proved could be only an island, and he explored Quiros' boasted discovery of Tierra del Espiritu Santo and partly surveyed what turned out to be only an insignificant island group (New Hebrides).

"Had we found out a continent there," he wrote, "we might have been better enabled to gratify curiosity; but we hope our not having found it, after all our persevering searches, will leave less room for future speculations about unknown worlds waiting to be explored." At the same time he believed that there probably was land to the south of his track, though he committed his one great error in judgment when he wrote: "Should anyone possess the resolution and the fortitude to elucidate this point by pushing yet further south than I have done, I shall not envy him the fame of his discovery, but I make bold to declare that the world will derive no benefit from it."

The evidence for a southern continent in temperate latitudes was shaky, and the conception was losing

support when Cook started on this voyage. He demolished the idea. His work though negative was of the highest value. In fact, so thoroughly did he establish a disproof in the conception of this elusive continent that it was a slow and arduous task to recreate belief in a great southern land mass when in the nineteenth century confirmatory evidence came to hand. A generation or more passed before any serious attempt was made to penetrate Antarctic seas, and even when land was discovered in the far south in the third decade of last century it drew little attention. It was not until 1886 when Sir John Murray, arguing from scanty circumstantial evidence, revived the conception of a great continent, and with his habitual sound judgment drew an outline of its shape that subsequent exploration has little modified.

The Last Achievement.

In his third voyage in 1776 Cook solved some further problems in the Pacific and added to his many discoveries, but his attempt to find a north-west or a north-east passage—the main objects of the voyage—was a failure. So desirable did such a passage seem to be for the commerce of Britain that in 1745 Parliament had offered a reward of £20,000 to the discoverer of a north-east passage. Before Cook sailed the reward was extended to include the discovery of any passage between Atlantic and Pacific north of latitude 52°N. Cook's explorations with the *Resolution* and *Discovery* were extensive. As usual he charted many coasts and added new features to the map. Tracing the coast of North America northward from Vancouver Island he thought he had found the north-west passage in Cook Inlet, and eventually, after passing Bering Strait, reached Icy Cape in the Arctic Sea before pack-ice forced him to turn. On the Asiatic side he had no better luck, but it was characteristic of Cook that the failure to the east and the danger of ice did not deter him from attempting to find a road by the west. This was Cook's last great feat of exploration. He intended to return to the quest the following summer, but was slain at the Sandwich Islands in February, 1779. His successor in command, Captain Clarke, imbued with Cook's high determination, endeavoured fruitlessly to better Cook's record.

Much of Cook's success was due to his perseverance, his fine seamanship, and his qualities as a leader. But it must be remembered that in his day the great difficulty in any long cruise was the likelihood, even the certainty, of loss of strength and life through the disease of scurvy. Every vessel that was at sea a few months suffered from it. No preventive or cure were

known. Anti-scorbatics of doubtful efficacy of which the chief was sweet-wort made of malt were used. Cook realized that scurvy was the great enemy he had to face, and he fought it with every means his experience could suggest. Some of his measures were of value; others were probably useless as preventives. He supplemented the issue of wort with sour krout, mustard, vinegar, broth, orange and lemon juices and vegetables. And best of all, he missed no opportunity of gathering wild celery, scurvy grass, and other herbs. Perhaps the cleanliness on which he insisted in the fo'c'sle, an innovation in ships of that time, did not combat scurvy, but must have added to the health and comfort of his men. At any rate, his efforts were successful. Scurvy was rare, and death from the disease unknown on his ships. The crews maintained their health in a way that was considered marvellous in those days. This was the secret of his long voyages, the time he was able to spend at sea and the relative short stays in port he required to recruit the health of his men. The mastery of scurvy, or at least the ability to keep its ravages in abeyance, was not the least of Cook's triumphs, though the explanation of his preventive measures was not found till a later date.

There are no descendants of Captain Cook. Only one of his six children reached maturity and he died unmarried. Captain Cook's wife died at the age of ninety-three, and was buried in the Church of St. Andrew the Great, Cambridge, where a memorial tablet to Cook and his family was erected.

New Value from Gas Wastes.

In the course of a new inquiry at the organic chemical laboratory of the United States Bureau of Mines, Washington, into the cause of gas-meter stoppages, it was found that the main cause of the trouble was gum formation from indene and styrene. These compounds are always present in manufactured gas. In freshly made gas they are very volatile and readily carried in the gas stream, but on standing in contact with other gas constituents they tend to "polymerize" or form gums.

A recent survey of the American gas industry shows that there are eight million pounds per year of styrene and twice that amount of indene available if completely removed from the gas. These compounds could be used in the manufacture of plastics, and styrene used for perfumes and possibly in rubber manufacture. It is suggested that here is a field for the development of substances which are now admittedly industrial nuisances.

American Views on Rocket Flying.

In July DISCOVERY published Herr Max Valier's second article on experiments in rocket flying. Since that date the "Scientific American" (August) and "Science and Invention" (September) have each published similar articles, which indicate the wide attention attracted by the German inventor's proposals.

As one of the pioneers in rocket-flying investigations is an American—Professor Robert Goddard, of Clark University—it is to be expected that the scientific Press in the United States are following eagerly the new German experiments of Herr Max Valier. A first practical proof of the power of rockets was given by the recent rocket-car test, described in *Discovery* by this inventor, who added some remarks on proposed flying developments. The new information briefly supplemented the detailed plans published in our columns a year ago, and its only serious significance was to show that Herr Valier is still pursuing a fascinating problem. That the scheme is impractical with present devices *Discovery* made no attempt to disguise, a fact which is emphasized by a highly speculative article in *Science and Invention*, edited by Mr. Gernsback. Yet as the title page of this American magazine appropriately affirms, Huxley once stated that "those who refuse to go beyond fact rarely get as far as fact." Rocket flying—like the early attempts at our present aviation—certainly needs imaginative thought if its difficulties are ever to be solved.

The Fuel Problem.

One branch of this research which already lends itself to practical experiment is the problem of fuel, and on this some comment is made by Mr. Gernsback. "As is well known," he writes, "the usual rocket uses a mixture of black powder and other chemicals, and the reaction during firing lifts the rocket up into the air. As soon as the powder has burned itself out, the rocket comes down to earth, so the problem, from the engineering standpoint, is to have enough rockets to explode or enough fuel constantly fed to one rocket to keep the machine, whether automobile, airplane or space flyer, going indefinitely.

"Years ago, I conceived the idea of a dynamite motor, the idea being to explode small charges of dynamite in a cylinder by feeding cartridges on a belt through a special device. The ensuing gases were then expelled to propel the machine. Unfortunately, the crude experiment soon came to a close, because the engine blew up; fortunately, without hurting myself and my co-experimenters. But I see

no reason why, with proper safeguards, such a propellant could not be used, working on the rocket principle.

Dynamite.

"Dynamite is a fairly safe substance to handle, if it is used in the correct manner, and its propellant force, as compared with black powder, is inordinately greater. This is because the amount of gas liberated by dynamite is three times that of black powder, such as is used in rockets. There may, of course, be found other fuels that can be used for rocket propulsion, because there are many more powerful explosives than dynamite known to science to-day. The idea of using such powerful explosives may at first appear fantastic, but no more fantastic than exploding gasoline and air mixture in the present day motor-car. The difference between the explosive force of gasoline and air mixture and nitroglycerine, for instance, is only a matter of degree and speed of concussion. It all comes down to handling the fuel in a safe manner. While vastly inferior to dynamite as an explosive basis, gasoline is used to-day only because its liquid form gives a comparatively simple way of handling, which is not the case with dynamite, and liquid nitroglycerine would be too dangerous."

On the other hand, Professor Goddard himself is far less guarded in a prefatory statement to an article in the *Scientific American*: "If atomic energy were available, it would be a very convenient means of propelling an interplanetary rocket. Atomic energy is not, however, necessary, as an interplanetary flight is possible with means even now at our disposal. This is set forth in my article in the Smithsonian Miscellaneous Collections for 1919. If a propellant of high energy content, such as hydrogen together with oxygen, is used with high efficiency and in the proper way, an interplanetary flight is possible in a rocket that is neither tremendously bulky nor unwieldy. A rocket using a low energy propellant, and operating inefficiently, would, on the other hand, be impracticably large. The technique of such a flight constitutes a most interesting problem in physics, and is one to which I have given considerable thought for many years. In the light of the conclusions I have reached, I can say that, although Mr. James

R. Randolph's article, 'Can We Go to Mars,' may read like romance, it is nevertheless thoroughly scientific, and, while not telling the whole story, it gives a good picture of what an interplanetary rocket must be like."

A Peep at Mars.

In publishing the article referred to, Mr. O. D. Munn, the editor of the *Scientific American*, "makes no apology," and he explains that the plan is theoretically sound: "It is not a Jules Verne story nor an H. G. Wells story, nor even one of Dr. Hacksaw's secrets. It is a physicist's conception of a method for getting close enough to Mars to see what Mars is really like. The article was first submitted to several laymen for opinion. They voted against it. It was then sent to several physicists. These favoured publication. In itself this may have some significance. Mr. Randolph's plan cannot, of course, be realized at present; he says so himself." As, however, it gives a new approach to the problem and the machine described closely resembles Herr Valier's own rocket ship, the plan is of particular interest.

Briefly, instead of "shooting" at the moon, an attempt would be made to reach Mars, which in Mr. Randolph's opinion presents the most interesting possibilities. "The space between the two planets is devoid of air, or any other kind of matter," he writes. "Hence, there is only one way in which such a trip could be made. A projectile of some sort would have to be thrown off from the earth with sufficient velocity to clear the earth's attraction, and would then have to be directed into an orbit that would touch the orbit of Mars at the time Mars got to that particular part of it. Then, its velocity would have to be reduced so that it could be captured by the planet and become a satellite. Such it would remain for about a year, at the end of which time its speed would have to be increased, returning it to its own orbit, and thence back to the earth.

"Thus the projectile would have to be able to change its velocity in a vacuum, and at the start it would have to attain a velocity of seven miles per second, as that is the velocity needed to escape the earth's attraction. There is only one device known to science at the present time with which these requirements could be met. That is the high-altitude rocket invented by Professor Goddard. . . . Engineering difficulties may be looked for because of the enormous size of the machine, and the cost will be very great, but the plan is by no means impossible."

To design a small-scale apparatus is, of course,

quite an easy matter compared with the conditions involved by one large enough to be capable of leaving the earth and of carrying men. By way of illustrating this difficulty, Mr. Randolph writes: "A brick pier a few feet high would support a weight of 4,000 pounds for each square inch of its surface. But a pier a mile high weighs more than 4,000 pounds per square inch of horizontal section. Hence it would break of its own weight, unless spread out like a mountain to give a broader base. Five miles of steel wire form a heavier weight than the wire itself can support. And as these limiting weights are approached, the proportion of structure to useful load increases, and the skill required in design becomes greater, in order to keep this proportion down.

"In a rocket, all loads would be greatly increased by the rapid acceleration at the start, but this could be calculated in advance and allowed for. Acceleration in a rocket like this is under perfect control. The numerous small charges are fired by a time clock, and at any rate desired. Even in the simpler rockets, like Goddard's present forms, there are ways of controlling this, as by making the grains of the powder small or large. The smaller the grains the faster the powder burns. But in an actual trip the acceleration should be made just as great as the passengers could stand. This would be tried out beforehand, possibly in a rapidly revolving drum, and the start of the rocket governed accordingly."

Two Years Journey!

After describing in some detail a proposed rocket machine, Mr. Randolph reverts to the problem of its flight. "This rocket," he proceeds, "when clear of the earth, would be given an added velocity of about two miles per second in the direction in which the earth is moving with a velocity of 18.5 miles per second. This would throw it into a much more elliptical orbit, which would bring it to the orbit of Mars about seven months later. Departure would be so timed that Mars would be there when it arrived. It would then be slowed down until it became a satellite of Mars, which it would remain for about a year. Then, the positions of the planets being suitable, it would be speeded up and brought back to earth. A large and heavy mass like this, approaching the earth at seven miles per second, could not be safely landed. Hence it would be abandoned when near the air, and the occupants would come down in the landing plane [specially carried for the purpose in the rocket]. This is a small air-tight glider, with folding wings, and having a special door to permit its release.

"A rocket such as this would weigh as much as an ocean liner, but would probably be easier to design, as the structure is more compact and the forces more definitely known. But its accommodations would be severely limited, as food, water, and even oxygen for the entire journey of over two years would have to be taken along."

To English readers, notwithstanding the maxim from Huxley earlier quoted, there is something curiously naïve in the solemnity with which Mr. Randolph next remarks that, "because of its high cost, and the lack of a financial motive for the trip, it is likely to be a long time before such large rockets are built."

Exploring the Atmosphere.

It is interesting to learn, in conclusion, that the Goddard rocket in its present size has now reached the stage when it could be used for exploring the upper atmosphere, beyond the range of sounding balloons. The next development that is planned is the study of the Heaviside layer, which exists at an altitude of about sixty miles above the earth's surface, and is believed to play an important part in the transmission of radio signals. It is also hoped to take astronomical photographs from outside the earth's atmosphere. Eventually, for the larger experiment, a preliminary method proposed is the projection of a small mass of magnesium powder to the moon.

A similar French scheme to use rockets for upper air exploration, as reported in *Nature*, was the subject of a lecture before the Société Astronomique de France, the president of which, General Ferrié, contributes a commendatory preface to the printed report. The subject has been studied by the author, M. Esnault-Pelterie, for twenty years, as well as independently investigated more recently by Oberth and Hohmann, besides, of course, Valier and Goddard. In a discussion of experiments on the propelling power of various explosives, M. Esnault-Pelterie considers the conditions of ejection, both neglecting and taking into account the resistance offered by the earth's atmosphere. Like Professor Goddard, he concludes that it is already practicable to send exploratory apparatus of small mass to heights of some hundreds of kilometres; but that it is not at present practicable to eject enclosures large enough to contain human beings, with all the necessities for their existence on a journey outside the earth's region of attraction, together with a sufficient supply of the propellant explosive to ensure their safe return.

Whether the French will beat the Americans in exploring the upper atmosphere remains to be seen.

Correspondence.

AMAZON NATURAL HISTORY.

To the Editor of DISCOVERY.

SIR,

In your August issue, page 264, are some interesting photographs of wild life from the Amazon Valley. Figure 2 is that of "a brilliant bird of the Cormorant family." The common name of this bird is Darter, or snake bird, belonging to the family Plotidae of the order Pelecaniformes. It is also called snake-neck from the habit it has of swimming with the body submerged and only the neck exposed above the water, so it really looks not unlike a snake coming along.

Figure 4 is described as "a raccoon taken at Para." It is a member of the same group as the raccoons, but has a longer snout, the skull is relatively longer and narrower; it is the Coatimundi. There are two species, the white-nosed coati (*Nasua nasica*) which inhabits Mexico and Central America, and the red coati (*Nasua rufa*), inhabiting South America from Surinam to Paraguay. These animals are mainly arboreal, their food includes fruits, young birds, eggs, lizards, and insects.

The other figures in the plate of photographs from the Amazon Valley are also interesting, but these are more fully described. *Discovery* is of particular interest this month to the naturalist.

Yours faithfully,

J. W. CUTMORE,

Late Keeper of Zoology to the
Liverpool Free Public Museum.

65 Derby Lane, Liverpool.

A FOREIGN SUBSCRIPTION LIBRARY?

To the Editor of DISCOVERY.

SIR,

I should be very grateful if you could inform me whether any library exists from which, for a moderate subscription, modern foreign zoological works, German ones in particular, could be borrowed. I frequently wish to find out the most recent work done abroad in the various branches of this subject, but have been unable to get sufficiently modern and advanced books or papers. I have applied, among others, at the London University General Library, and the Central Lending Library for Students, and also at the Science Library. The officials at the Natural History Museum are always most kind and ready to assist, but one hesitates to apply there as often as is necessary, because that library has no accommodation for general readers, and is, I believe, not intended to be used in that way. Further, it is not a lending library. It appears that the British Museum at Bloomsbury has such works as I require, but, of course, for reference only. The library of the Zoological Society is open only to Fellows of the Society, and the entrance fee and the subscription, which amount to eight guineas, is more than many ordinary students can afford.

I have been greatly assisted by the articles published in your paper from time to time on the work done abroad, by von Frisch and others, but, of course, these are not sufficiently detailed. I hesitate to trouble you in this matter, but perhaps others among your readers have met with similar difficulties.

Yours truly,

LONDON STUDENT.

[At short notice since this letter was received, we have been unable to trace our correspondent's requirement. As this is of general interest, information will be welcomed.—Ed.]

Promoting Growth by Ultra-Violet Light.

By L. V. Dodds.

Ultra-violet light is being successfully applied to animals and plants by the London Zoological Society and the Royal Botanic Society. This interesting work supplements the medical and industrial applications.

CONSEQUENT upon recent developments in the therapeutic uses of sunlight and the remarkably beneficial results obtained, those engaged in light research have given considerable attention to promoting the growth and increasing the vitality of plants and animals by the aid of ultra-violet light. Many experiments have been made, and from the data now available it is recognized with certainty that this field offers enormous scope and is one in which the commercial developments may well prove of national importance.

Two Methods.

Two methods are being used for this work, one using natural sunlight to the maximum capacity and the other employing rays generated artificially. Obviously the chief difference between the two is that whereas the former can be used for comparatively large areas, the latter method is entirely localized. Furthermore, the expense of sunlight lamps limits their use for some time to come. It is customary to decry our British climate, but a study of the official meteorological records will show that actually the country receives a considerable amount of sunlight. The trouble, therefore, is not so much with the supply as with the way in which the light is used. Smoke pollution of the atmosphere effectively prevents a large proportion of the ultra-violet rays from the sun ever reaching the earth at all, and the widespread use of glass which cannot transmit these rays effectively screens the remainder from all buildings and enclosures not fully exposed.

Schemes for smoke abatement are improving the atmosphere, and the invention of a true glass which will transmit as much as eighty per cent of these rays essential to health has resulted in many extraordinarily successful developments. Mr. F. E. Lamplough first produced a glass of this type, and his invention is now being marketed extensively under the name "Vitaglass." This material is a true glass and is designed to replace ordinary glass in all its uses, but other materials capable of transmitting a high percentage of ultra-violet light are now available, and many of them are especially designed for use in farm

buildings, greenhouses, solariums and the like, where actual visibility is not so essential as in private homes and hospitals. The most usual types of materials intended for such uses are made of a cellulose acetate compound, often reinforced with a fine wire mesh of galvanized wire. There are naturally variations in each product, but the results, while not admitting so much visible light as ordinary and special glass, are eminently suitable for use in agriculture, horticulture, and stock-keeping. These materials can be made at less expense than a true glass, and they are being used extensively by practical farmers.

The experiments of the Royal Zoological Society of London have aroused widespread interest. At the well-known gardens in Regent's Park, the monkey house, the lion house, and the new reptile house, have each been roofed with Vitaglass, while for special purposes tungsten lamps have also been used. Reporting on the work Dr. P. Chalmers Mitchell, Secretary to the Society, states that the use of the glass and of ultra-violet light from electric bulbs "seems to have notably improved the general health and vitality of the apes and monkeys and the carnivora to which it has been applied."

In the Farmyard.

The installation of this special glass has followed in many racing stables, cowsheds, and training establishments in this country, as well as on the continent and in America. Many experiments on the irradiation of pregnant cows and pigs have been made by workers in Germany, and the results show that it is even possible to compensate for a diet deficient in vitamin by using ultra-violet light, and such methods have been adopted recently on a Surrey farm with very satisfactory results. The new greyhound kennels at Denham, Bucks., said to be the finest in the country, are the latest addition, while the King's filly, "Scuttle," winner of the Two Thousand Guineas, is one of several well-known race-horses which regularly receive general irradiation from ultra-violet lamps in order to maintain health at the highest standard.

One outstanding feature of the Zoological Society's work is that it has been shown very clearly that while

natural sunlight used to its maximum extent by the new glass is almost always beneficial, the exposure of animals to tungsten lamps may be attended with serious consequences. A very short exposure caused the death of several reptiles, while a shorter treatment than would be given to a human being was applied to a rickety young elephant and the animal was badly burned. Several birds, too, died from excess of sunlight supplied by this means. It would appear that the artificially generated rays are too powerful in many instances, and certainly further experiments must be made on the vexed question of essential dosage before these lamps can be used on the farm with safety.

Another indication of the varied ways in which these researches are being conducted is given by the work of two French scientists, M. Phisalix and M. Pasteur, who have made experiments intended to discover whether ultra-violet rays would destroy the venom of snake poison. It was found, however, that the rays destroyed all the elements in the venom that were not dangerous, but left the virulence of the poison untouched.

Animals are protected by a thick covering of hair which it is not always possible to remove, and in treatment with ultra-violet light artificially produced there is a great hindrance to the penetration of the rays. By continually rubbing up this hair while the exposure is being made, penetration is assisted considerably but the length of the exposure must be increased. The hair is less dense under the thighs, and treatment so directed may be more effective. To give the animal a good wash is also of considerable help, as for protective purposes animals have been provided with a much thicker skin than man and they



SUNSHINE AT THE ZOO.

The inventor of Vitaglass, Mr. F. E. Lamplough, is here seen in the lion house at the London Zoo, where this special glass has been installed.

do not wash as frequently. Because of this, a thick layer of epithelium and grease is formed, which acts as a waterproof covering and also as a dense screen to the rays. There is a great variation in these points between different breeds of animals and every patient of each breed, so that each case must be considered separately when determining the exposure. Apart from general tonic treatment, alopecia, eczema and rickets respond readily to irradiations, while it is also useful in pneumonia, catarrhal fevers, and to some extent in chorea.

The new glasses have been used with much success in greenhouses, and writing of one of these materials Professor Leonard Hill, of the Medical Research Board, states: "It is possible that the results of experiments with 'Windolite' on growth of plants and their anti-rachitic and growth vitamin qualities may profoundly alter greenhouse practice. Enough has already been done to show that growth and fruiting are altered by giving or withholding ultra-violet rays. It has also been shown that the successful raising of chickens, and the laying power of hens and the fertility of eggs, are increased by ultra-violet radiation."

In tests made at Kew it has been established that seeds grown under Vitaglass germinated twenty-four hours before those grown under ordinary glass, and after three weeks the plants are sturdier and of a deeper green. Tomatoes which receive the maximum amount of rays by this means ripen in advance of those grown in the usual manner, while lettuces were stronger, with bigger hearts, and of a richer shade of green. By adopting the use of a glass of this type it would seem that the British market gardeners would be able to compete successfully against foreign growers by hastening forward their plants and selling them before the market is glutted by continental produce. In several instances similar tests are being made and



ULTRA-VIOLET TREATMENT FOR GREYHOUNDS.

This application of light is found to be beneficial to the dogs, which are now frequently treated in this London laboratory.

each reports satisfactory progress. Messrs. Toogood and Sons, the Southampton seedsmen, are carrying out several experiments under the glass on small seedlings, both flower and vegetable, to study the effect on "damping off." They are following actual rapidity of growth with a perennial rye grass test. Westfield College, London, are raising various kinds of seeds for South Africa, and the head gardener reports that under the new glass bedding plants are blooming much earlier. A third test has been begun by the authorities at Kew, in which a greenhouse is used fitted with four different kinds of glass in sections, ordinary glass, both clear and opaque, and similarly special glass. The same plants will be grown under each type of glass during the summer.

Experiments on Plants.

Not all plants are amenable to treatment with ultra-violet light. An experiment at Manchester with the seed hips of roses produced no apparent effect whatever, though the leaves of the plant showed marked development. This test, however, must not be accepted as conclusive for the dosage may have been at fault. Further work of similar kind has been done at the gardens of the Royal Botanic Society, London, and, as reported in a recent issue of *The Times*, these are of especial interest to owners of conservatories and aquaria. These experiments were designed to show particularly the development of plant growth aided by the sun's ultra-violet rays. The curator of the gardens, Mr. J. L. North, states that two bowls of equal size filled with water were used, and in each one was placed thirty plants of *Lemna Minor*, the Lesser Duckweed which is so common on ponds throughout the country. One bowl was covered with Vitaglass and the other with ordinary glass of the same size and thickness, and the two were placed together outside the Museum, in such a position that no sunlight could reach them until after mid-day. To admit air and decrease condensation the glass was tilted slightly on one side. After twenty days the two bowls were examined, and in the one covered specially fifty-four plants were found while in the other there were only forty-one, thus proving that by the aid of ultra-violet rays propagation had been more than doubled.

These tests are admittedly tentative experiments only, yet the satisfactory results obtained with a plant like *Lemna*, which is a very primitive growth requiring no soil for its subsistence, indicate to some extent the developments which may be expected with a plant of more advanced type that has a greater amount of foliage to absorb the sun's rays. Recent

demonstrations in greenhouses support this theory and, as this knowledge becomes more widely known, the results will be of corresponding importance from both a scientific and economic standpoint.

Research is also being made into the possibilities of accelerating plant growth by the use of ultra-violet rays from lamps. As with animals, ascertaining the correct dosage is one of the chief difficulties, and so far, except in special instances on which it is unwise to base an opinion, the results of such experiments have not been so satisfactory, and some considerable time will elapse before quartz lamps are used in the garden to any great extent. To indicate the scope of the work, however, in America the Wisconsin Agricultural College claim that grain and sugar cane can be made to mature more quickly under ultra-violet light.

Poultry farmers have already benefited considerably by the new glasses, and very careful tests have been made with the object of their commercial application in this way on an even more widespread scale. One of the greatest difficulties with which the poultry keeper has to content is leg weakness in chickens, and it is a common source of loss. Research has shown that when Vitaglass is used in the brooder, leg weakness does not occur and, moreover, the chicks do not suffer from many of the other ailments to which they are subject. The growth of the chickens is also affected beneficially, and it is claimed that they are in lay very much earlier than those reared under ordinary glass. The value of this means is specially useful in the case of winter and autumn chickens when the weather will not permit the use of an exposed run, and in this way also it may be possible for poultry keepers in England to contend more successfully against foreign importers.

Future Developments.

The importance of ultra-violet light, both from the sun and produced by artificial means, in relation to plant and animal growth, is very considerable, and scientists both in Europe and America are concentrating on the further development of a discovery which will entail far reaching results. Professor Hill says that the use of a suitable window glass "may profoundly alter greenhouse practice," but in the future, the advanced application of ultra-violet radiations may largely necessitate the reorganization of our present agricultural and horticultural methods, while the effect on stock-keeping will be correspondingly remarkable.

Thus this research is now extending its scope from industry and medicine to modern farming practice.

Canada Saves the Big Horn Sheep.

By Dan McCowan.

In our July issue Mr. H. J. Massingham described the present rapid destruction of mammalian life throughout the world. By contrast a Canadian contributor sends us an account of how the Big Horn sheep has been saved from extinction in the Rocky Mountains, where it once more flourishes in large numbers.

At the opening of this century all the wild sheep on the eastern slope of the Canadian Rockies could have been accommodated in an ordinary railway truck such as is used in the transportation of domestic stock. To-day, in the mountainous region round Banff and Lake Louise alone, enormous numbers of Big Horn sheep are to be seen, and it has been estimated that in Banff National Park at present there is a wild sheep population of over twenty thousand. This condition, so pleasing to record, has been brought about as a result of conservation measures taken by the Dominion Government at a time when it seemed as if this fine animal would become extinct.

The "Big Horn" is a bold mountaineer, stocky in build, surprisingly agile, and altogether well adapted to live on the high plateaus. Indeed, it would almost appear that he has become inspired by the strength and dignity of his lofty environment. Always he seems clean and fresh as the flowers that bloom on his native meadows, and he walks with a proud step on the highlands on North America.

A full grown ram stands about thirty inches high at the shoulder, and when in prime condition weighs from two hundred to two hundred and fifty pounds. Ewes are considerably smaller and lighter than rams. Both males and females are furnished with horns, the ram horns being very massive and gracefully curved. Those on the ewes are short, flat, and but slightly curved. Unlike the members of the deer

family, sheep do not shed their horns annually, and so, from prominent wrinkles in the horn—each one marking a birthday—one may not only ascertain the age of the animal, but also how it has fared on the journey through life. Years of plenty and years of famine are there indelibly etched. On old rams the horns are badly stubbed and frayed through contact with rock and stones, and as a result of the strenuous fights which take place annually amongst rivals for possession of bands of ewes. It is interesting to note that while females of the species seldom venture far from the valley or hillside where they were born, rams are notoriously roving in disposition, travelling long distances in a very short time and ranging over a wide territory. In this way nature guards against the danger of inbreeding.

Lambs come towards the middle of May or early in June. Twins are common, but triplets are seldom seen. Like their domestic cousins these young sheep are playful creatures, loving to scamper and frolic amongst the crags and across the upland meadows. Even when but a few days' old they seem surprisingly agile and altogether fearless, ascending and descending precipitous places without the least hesitation. The surefootedness of the white goat of the Rockies has for long been proverbial, but even he does not "watch his step" half as well as the mountain sheep when scrambling amongst the cliffs and crags of home. The goat, in all his movements, is deliberate and



IN THE ROCKY MOUNTAINS: A FULL-GROWN RAM (CENTRE), WITH GROUPS OF YOUNG SHEEP

cautious, the Big Horn, by comparison, seems reckless and foolhardy. At times a false step would result in death to the daring animal, yet seldom is there fatality or even injury from such cause. Indeed, this impetuous creature depends on daring and dash when striving to elude that giant weasel, the wolverine, to outstrip the pursuing wolf, to avoid the claws and teeth of the cougar, and to escape the whirling sweeping avalanche that thunders into the valley.

The wild sheep of the Canadian Rockies are singularly free from disease; in fact, there is no record of an outbreak occurring amongst these animals in their native haunts. During April and May they are sorely infested by ticks which, although doubtless a source of great annoyance, do not seriously impair the health of their hosts. The natural term of life granted to these sheep is from fifteen to eighteen years. When old age dims the eye and stiffens joints and muscles, when the thin air of high altitudes scarce

serves to fill the lungs, the weakening animal descends into a quiet valley and there, in some secluded nook amongst the friendly trees, goes peacefully to the last sleep of all.

Much pleasure may be derived in watching and studying Big Horns in their native habitat. Striving to obtain photographic trophies of a group of rams or a small flock of ewes and lambs, one is lured upwards from the verdant pasture places on lower slopes to the great ramparts where trees scarcely find a rooting. Then on and on, climbing higher and yet higher amongst limestone cliffs and through gritty shale till the clean cold region of snowfield and glacier is reached. There is a solemn grandeur in such remote and unspoiled places. The clouds seem near at hand and kindly, the everyday world is far away and forgotten. Resting in the shadow of a great rock there comes to one an infinite peace in contemplating the handiwork of Him who tends the wild sheep on a thousand hills.

Among the Stars: A Monthly Commentary.

By A. C. D. Crommelin, D.Sc., F.R.A.S.

THE giant planet Jupiter is coming into a favourable position for observation, being in Aries, some 12° to the south-east of Hamal, the chief star of that constellation. It is interesting and useful to study the ever-changing surface markings, and to note the different rates of rotation of different regions, which are determined by observing the times at which various spots cross the central meridian. The equator goes round in 9 h. 50 m., while the temperate zones take five minutes longer. The satellite phenomena are also attractive to watch; there is an eclipse of satellite III on 2nd September, disappearance being at 1.1 a.m. (summer time) and reappearance at 3 a.m.; both occur low left of the planet in an inverting telescope.

Uranus and Mars.

Uranus is also well placed for observation. It is in Pisces, some 3° east and 13° south of Gamma Pegasi, which is the low-left component of the "Great Square." It may be glimpsed with the naked eye, and is quite easy with good binoculars. In the telescope its disc appears greenish; large instruments are necessary to see any markings on the disc, or to detect the satellites. Mars may be observed in the latter part of the night. It passes near Zeta Tauri (the southern horn of the Bull) on 18th September and will reach opposition, in the feet of Gemini, on 21st December, though it will be nearest to the earth on 15th December. Its high north declination is favourable for observation.

It is also worth while to note that the tiny planet Eros passed opposition on 27th August. On 5th September it is $40'$ south of Theta Pegasi, and on 21st September it is 5° south of Epsilon Pegasi. Its magnitude on this occasion is only 11, but at the next opposition, in January, 1931, it will reach magnitude 7, being then within fifteen million miles of the earth. Extensive preparations are being made to observe it then, in order to obtain an improved determination of the sun's distance.

There is at present a lull in cometary observations, after a period of great activity. No observations have been reported since 24th May. Search is, however, being made for two periodic comets. The first is that discovered by the late Mr. Edwin Holmes of Islington in 1892, one of the few comets discovered in London. It was then a naked eye object, but some temporary disturbance must have caused unwonted brightness, as it was extremely faint at the two following returns in 1899 and 1906. It has not been seen since 1906, but this was owing to the death of Dr. Zwiers, who attended to its perturbations. These remained neglected till Mr. Polak, and subsequently Mr. Cripps, took up the work, and found that the comet was due at perihelion about 23rd March, 1928; it was then so near the sun in the sky that observation was hopeless, but it is now better placed.

The other comet is also a British one, having been found by Mr. C. Taylor at the Cape in November, 1915. It was a fairly bright object, and was observed for six months. Like Biela's comet it divided into two portions. It must have returned to perihelion in June, 1922, but escaped observation then, being badly placed. It is due at perihelion at the end of next October, and may be observed during September. It is moving nearly due east, from Gemini into Cancer.

The variable star Mira Ceti passed through maximum brightness at the end of August, and it should be an easy naked eye object throughout September. Its position is R.A. 2 h. 16 m., S.Decl. $3^\circ 18'$, and therefore it is some 17° south of Jupiter. The best way of estimating the brightness of variables is to find two neighbouring stars, one brighter than the variable, the other fainter; we then judge that the brightness of the variable is one-third (or whatever it may be) of the way from the first to the second. Alpha Gamma, Delta, and 75 Ceti are suggested as comparison stars; their magnitudes are 2.7, 3.5, 4.0 and 5.6 respectively. The first two are suitable when Mira is near maximum, the others later on.

Book Reviews.

From Magic to Science. By CHARLES SINGER. (Ernest Benn Ltd. 25s.).

Dr. Charles Singer has a wide and well deserved reputation as an authority on the history of medicine. In the present book his scope is somewhat wider, in that general science comes prominently into the picture, and the collection of essays is arranged in such a way as to form a delightful commentary on the emergence of science. He traces its evolution from the stark utilitarianism of the Roman era, through the ecclesiasticism of the Middle Ages, and the magic philosophy of Hildegard, to the dawn of the true scientific era at the beginning of the sixteenth century. It is impossible adequately to review this book after one reading, for the pleasure to be culled from the author's profound erudition and artistic treatment of the subject is cumulative in effect. It is one of those pleasures to be reserved and slowly enjoyed in the lengthening autumn evenings.

The first essay, "Science under the Roman Empire," is above all things comprehensive. There is an undeniable flavour of practical politics about the warning given some thirty years B.C. by the Roman writer Marcus Terentius Varro, not to build houses in the neighbourhood of marshy places. "Because when the marshes begin to dry they engender a multitude of invisible insects which are introduced into the mouth and nostrils with the inhaled air and occasion serious illnesses." It is to be hoped that the General Medical Council have placed a portrait of Julius Caesar in an honourable position, for it was he who conferred such exalted social status on the medical practitioner when he raised him from serfdom to the rank of a Roman citizen. It is to the practical policy of the Romans that we owe the hospital system. Dr. Singer describes the first hospital which was established on an island in the Tiber about A.D. 41-45. There is an amusing sketch of an instrument used by the Romans to measure distances along a road—surely it was the first ancestor of the modern taxicab? The Roman attitude to science and the manner in which natural phenomena were rendered subservient to the needs of the Empire are described by the author with the authority conferred by long familiarity with the subject.

The next essay deals with the mysticism of the Middle Ages. The words of the author himself best illustrate his method of dealing with this chaotic period. "It is beside the point to urge that the Middle Ages contributed little to the actual sum of knowledge of the external world. What we want to know is why they contributed so little." It is not necessary to remind the reader of the wealth of material which is included in the period of the Middle Ages; the truly supernatural genius of Copernicus, Kepler, and the painstaking observations of Tycho Brahe formed, from a universal morass of dubious philosophy, that firm basis of fact upon which the whole edifice of modern science now rests. In his treatment of this period it is difficult to think of any point of view which the author has omitted; but his detached standpoint is so well maintained that the reader may congratulate himself on the true perspective which is presented concerning this somewhat confusing period in scientific history.

Space does not permit me to describe in detail the subject matter of the remaining essays, but the author's reputation will be sufficient to recommend them. It is perfectly obvious that no expense has been spared in the production of this book.

Its price is twenty-five shillings, and it is ridiculously cheap. There are fourteen exquisite plates in colour, including some charming pictures of plants taken from mediaeval Herbals. There are also some delightful reproductions from the Hildegard manuscripts. There are one hundred and eight line drawings and diagrams, and a title page taken from a French manuscript of the sixteenth century. The title is truly descriptive, and, as I have already said, it is a painstaking work of great learning. It should not only be of interest and value to students of science and history, but it should also afford pleasure to artists and others who are in search of beauty.

V. E. PULLIN.

Skyward. By COMMANDER RICHARD E. BYRD, U.S. Navy. (G. P. Putnam's Sons. 15s.).

The Art of Flying. By CAPTAIN NORMAN MACMILLAN, M.C., A.F.C. (Duckworth. 5s.).

An Approach to Winged Flight. By JOHN D. BATTEN, M.A., LL.B. (Dolphin Press. 5s.).

Now that the non-stop flight across the Atlantic has been attempted both successfully and unsuccessfully so many times in the past year or so, we are apt to forget, amidst the glamour of the American successes, that this feat was first accomplished by the British airmen Alcock and Brown as far back as June, 1919. Commander Byrd pays great tribute to the courage of these two pioneers in attempting the flight with the unreliable aircraft engines of those days. He makes out a clear case for the three-engined plane as an important factor in such flights, and attempts to show that, provided due precautions are taken, these spectacular flights are more than the mere stunts which they appear to the public to be. A spectacular flight, the author urges, acts as an impetus to the development of aviation by arousing public interest. But are not the equally spectacular achievements of Sir Alan Cobham and Bert Hinkler infinitely more valuable in establishing future aerial routes, with nothing like the same unnecessary risk attached to them? Byrd shows clearly the great danger of taking-off with the heavy load of petrol necessary for a three-thousand mile flight, and his own descent into the sea forced by the weather conditions makes it obvious that there is an enormous element of luck, besides exceptional piloting and navigating skill, required for making a successful trans-Atlantic flight. The story of Byrd's polar flight of 1926 describes the part played by aircraft in the conquest of the Arctic. This expedition, like that of Amundsen a year previously, was well prepared for a forced landing in case of engine trouble, but he was more fortunate than the Norwegian in this respect.

An interesting description of the expedition to the South Pole which Commander Byrd is attempting this coming winter, together with an insight into the great amount of preparation which goes on "behind the scenes," before the start of an exploring venture, concludes this book. Whether the results obtained by the dozen scientists, coupled with the desire for adventure and the achievement of having reached both Poles, will justify the trouble, risk, and expense entailed, remains to be seen. At any rate, it is to be hoped that success will again crown the efforts of this intrepid airman.

"The Art of Flying" gives the test pilot's view of aviation. Captain Macmillan gives a very clear explanation of the elementary principles of flying, and his book shows what a vast amount of mathematics and mechanics enters into the art of building successful machines. An interesting account is given in more technical fashion, of different types of machines and

engines, with their performances and uses. The author talks about the qualities necessary for a man to be a good pilot, besides giving a description of the strains to which he is subjected when flying under unusual conditions, and the risks taken and work entailed in testing new planes.

The one obvious fact about the flight of birds is that they are not dependent on petrol for the energy necessary to propel themselves along. Mr. John D. Batten explains what is in his opinion the action of a bird's wings in flight, and gives an account of his experiments to produce a machine in which man could fly by imitating the action of a bird, namely, by using his own muscular energy. He describes the stresses and strains involved and the materials used to combine maximum strength with minimum weight. The author submits that such a method of human flight would possess the merits of noiselessness and safety. It would also give the flier exercise at the same time as transportation. But, in competition with modern mechanical aviation, such flight will only be interesting from the point of view of the triumph of the human machine over the forces of nature.

R. S. R.

The Life-Force in the Plant-World of Creative Nature. By ELEANOR HUGHES-GIBB, F.L.S. (Kegan Paul. 5s.).

The author's purpose is difficult to define; she wishes to "provide a thread which may serve as a guide, to suggest lines of thought, to incite, to interest, to lead on till a whole group of ideas are gathered together into a harmonious whole." The thread selected is "the life-force at work in the plant-world." This force is the directive influence at the back of the organic and inorganic worlds, some mysterious controlling agency which finds expression in the spirally disposed series of scales on a fir cone and in many other examples of rhythm. In a chapter on adaptability in plant-life the author proposes to follow the roads taken by certain groups of plants in response to the urge of the life-force within them; the structure of the flower is described in simple language, and special attention is given to semi-parasitic and parasitic flowering plants which have chosen "a path of adaptation to difficult circumstances which yet is surely not the true response to the urge of the life-force." In another chapter an account is given of the more excellent way adopted by leguminous plants, which take in paying guests as partners in the all-important work of procuring nitrogen from the air. Insectivorous plants, on the other hand, have been less fortunate in their attempt to utilize insects as a source of nitrogenous food. The dominant idea is the relation of plants to the life-force, the dominating force which blesses the efforts of some of the more fortunate and withholds a full measure of reward from others that have wandered from the path of evolution. In a section on Response the suggestion, attributed incorrectly to Sir J. C. Bose, that the movement of starch grains from one side of a cell to another is the cause of geotropic curvatures, is quoted as "a simple and clear explanation." The hypothesis is attractive, but it has not been generally accepted as a well-established theory. The book may have a good influence in encouraging observation and the habit of putting questions to nature by means of simple experiments, but the effect of the author's determination to regard plants in the light of human beings living in harmony or in discord with some life-force can only be to direct inquirers after truth along the broad and easy road rather than to induce them to follow the straight and narrow path. Miss Hughes-Gibb writes as an enthusiastic lover of nature anxious to induce others to

share the happiness which she has found in the companionship with plants; it may be that she would not wish her book to be regarded as a guide to the scientific study of botany.

A. C. SEWARD.

- (1) *The Rise of Modern Physics.* By HENRY CREW, Ph.D., Fayerweather Professor of Physics in North Western University, U.S.A. (Balliere, Tindall and Cox. 22s. 6d.).
- (2) *The Romance of Reality.* By BEVERLY L. CLARKE, Ph.D. (Macmillan & Co. 10s.).
- (3) *New Worlds for Old.* By R. G. LUNNON, M.A., M.Sc. (Methuen & Co. 2s. 6d.).

(1) Our first book is described by its author as a sketch, but it is really a somewhat comprehensive history of science from the American point of view. Physics is the fundamental basis of all science, and the history of its development is all too little known even by the students of physics themselves. It is the consideration of the history of a subject which enables us to assess its proper place in the scheme of things, and thus tends to prevent that deplorable bigotry which has sometimes characterized the specialist. Dr. Crew's book is good and very readable, but we should have liked more details. We recognize, however, that the subject is so large that it is manifestly impossible to do it justice within the limits of a small volume. The progress of the study of electric discharges in gases has had the most profound influence on the development of modern physics, and it is a pity that Dr. Crew does not give us a little more of the history of this important branch of the subject. The fascinating researches of Hawksbee, Morgan, Davy, Crooks, and Sir J. J. Thomson on this subject are of primary interest and should not have been omitted. Surely the name of Stephenson merits inclusion among those who were responsible for the development of the locomotive. The omission of any reference to him may be due to the fact that the author prefers to regard him as an engineer rather than as a physicist. The illustrations in this book, of which there are some twenty-four, are excellent and particularly well chosen. The reproduction of an engraving by J. G. Murray depicting the young Faraday assisting Sir Humphrey Davy at the Royal Institution in London is most attractive. There is a very good bibliography of the history of physics which will certainly be of value to all students. We can recommend this book not only as a volume of interest to the layman, but also to all students of physics who wish to realize the great traditions which vitalize their profession.

(2) "The Romance of Reality" is a different type of book, also written by an American scientific man. It is a picturesque account of scientific phenomena, and deals in such diverse matters as protoplasmic cell division, relativity, and the solar system. The author states in the preface that the book is not an "outline" nor yet a "story" of science. He has drawn freely upon an undoubted capacity for imagery, which may be of service in providing entertainment for those who are entirely ignorant of science and yet feel that they would like to form some idea of the meaning of scientific discovery. The book should have value as a pleasant means of acquiring a superficial idea of science. Not the least valuable part of this work are the illustrations. They are well chosen and reproduced, and form an interesting portrait gallery of eminent scientific men.

(3) It is perhaps a matter for satisfaction that there have been of late years a large number of authoritative books dealing with science from a popular point of view. It argues a gratifying increase of interest on the part of the general public. Mr.

Lunnon's book is based on a course of university extension lectures, and he deals with the development of physics and the properties of matter in a manner that is not only clear and concise but eminently readable. Mr. Lunnon does not "write down" to his readers, but he gives them a plain straightforward statement of the facts in a clear and interesting manner. The book is well produced and the price low. We have every confidence in recommending it as an excellent example of a simple and at the same time accurate statement of the modern position of physics.

V. E. P.

The Determination of Minerals under the Microscope. By JOHN W. EVANS, C.B.E., D.Sc., F.R.S. (Thomas Murby & Co. 7s. 6d.).

This book, which is an amplification of some of the author's previous papers, supplies a long-felt want because it deals in a remarkably simple manner with the principles underlying the identification of minerals by the examination of their optical characters. After describing the petrological microscope and the properties of light, Dr. Evans proceeds to discuss the methods employed in the identification of minerals as seen in thin sections of rock, and describes in detail the procedure in the examination of minerals by polarized light, and by means of their interference figures. Much of the mathematical detail with which such a discussion is usually accompanied is dispensed with, and the illustrations, of which there are many, are, with one or two exceptions, clear and easily appreciated, so that the book is intelligible to those who have not made a special study of the science of optics.

While it is invaluable to students, as an introduction to the methods employed in petrological research, the book should prove most useful to those concerned with the quarrying, marketing, and use of stone, who may desire to know something of the properties of the material they are handling. There are chapters devoted to methods of determining the thickness of rock sections and the refractive index of minerals, and to the examination of minute crystals and fragments of crystals such as are used in the detailed study of crushed rocks.

The optical properties of individual minerals are not described, but a companion volume dealing with this aspect of the subject is promised, and, it is to be hoped, will soon be available; the two books would then constitute a complete but simple handbook of petrological methods.

F. J. NORTH.

Photographic Art Secrets. With a general Discussion of Processes by WALLACE NUTTING, D.D. (Chapman & Hall Ltd. 12s. 6d.).

This book contains a great deal that will be of practical value to photographers, whether they use a camera purely as a hobby or whether they use it for various professional purposes. The word "art" in the title is perhaps a trifle provocative, but the author shows that he has no illusions in that direction, as many photographers seem to have. It is obviously impossible to regard photography as entirely an art or entirely a science. Most good photography contains a big element of the same instinct for selection and arrangement which characterizes, for example, the work of the painter of portraits and landscapes. But whereas in the painting creation in the art sense continues throughout the whole process of production until the final touch is applied, this in photography can hardly be said to affect the result very much beyond the point of exposure of the plate.

Something, it is true, may be achieved in printing and in retouching the negative, and here, too, the artistic instinct plays an important part. But it is at this stage that there arises a divergence of opinion.

One class of photographer aims at producing no more than one perfect print, which is possibly achieved only with a great deal of work on the print itself. The other class aims at producing a negative from which any number of perfect prints may be taken. While there is perhaps no particular reason why these two groups should not exist side by side, it is certainly possible to argue, quite plausibly, that the first group are to some extent misusing their medium, and mixing hand processes with mechanical ones, a thing which to the pedant is not altogether satisfactory. The purist may desire either a good painting or a good photograph, but hardly the two combined.

Mr. Nutting realizes that theoretical propositions of this sort are not really of much importance. He says in his first line that a vast deal of nonsense has been uttered on the subject. "To forfend the quibble that photographs are not art, let us call them artisanship—when they are." He writes for those who wish to take good photographs, and he has nothing to say for those who "gain their pleasure merely from snapping a shutter."

The book contains a large number of specimen photographs which, in themselves, will well repay study and analysis. To each of these, in a final chapter, the author appends a note explaining generally why and how the negative was taken. That they are perhaps in some cases crowded rather too many on a page detracts from their individual qualities, but their quantity—there are over a hundred—is of distinct value.

C. E. H.

The Origin of Instinct: A Study of the War between the Ants and the Termites. By E. BUGNION, translated by C. K. OGDEN. Psyche Monographs No. 1. (Kegan Paul. 5s.).

This book is really a separate publication of Part IV of Auguste Forel's "Social World of the Ants," which was published at the same time. This part, by Bugnion, has been produced separately because it is regarded as an important memoir in connexion with psychology. The first twenty-eight pages are devoted to describing in a somewhat unconvincing way the habits of various kinds of termites in relation to ants. Then follow sixteen pages upon the subject to which the book owes its title.

Many will agree whole-heartedly with the statement put concisely in a footnote on page 29, that "we must of necessity assume intelligent processes at the beginnings of instincts, which are only hereditary habits," but this should have been the text for the whole book. The author distinguishes what he calls three categories of instincts:—(a) Instincts connected with defensive measures borrowed from Nature. (b) Instincts connected with anatomical structure or, in other words, the defensive organs of insects. (c) Instincts resulting from mental dispositions which, being of use in the conservation of the species, have become automatic. Each of these categories is dealt with in an impressionist manner, whereas each of them if properly expanded, would have made an admirable and fascinating chapter.

On page 39 the author states that "it is scarcely possible to compare a colony of insects with a human society," but the only reason he gives for this view is that the more advanced nations place kings, queens, and magistrates at their head but that nothing of this kind happens among the termites. Here

many will join issue with him. We seem to be following very closely the line of evolution of the termites. Whereas primitive human beings recognized chieftains and gave them power of life and death over their subjects, modern monarchs are very much in the position of kings and queens of termites and have to work hard for their living.

In primitive human groups, as in primitive animals, the male was dominant and the female subservient, whereas in modern human groups, as in social insects, sexual distinctions tend to disappear. Among termites birth control is recognized, the queen being fed or starved according as individuals are scarce or plentiful, and among them also the destiny of the offspring is determined by the requirements of the colony. Among the more advanced human societies birth control is now a common topic of discussion, and the struggle for existence is automatically forcing individuals to take up whatever line of work offers a livelihood, regardless of tastes and qualifications. It may well be that, before long, each individual allowed to be born will be detailed to a particular occupation by a democratic government, as in the termites.

The only difference between social insects and human beings seems to be in the amount of intelligence and consequent power of individual adaptability. In the social insects evolution has been in the direction of race memory or instinct. In human beings race memory, although it exists, has never been developed because intelligence has taken its place.

FRANK BALFOUR BROWNE.

A Place among Men. By CAPTAIN GERALD LOWRY, F.R.G.S.

With foreword by FIELD-MARSHAL VISCOUNT ALLENBY, G.C.B. (Mondiale. 2s.).

Whatever may be the feeling in regard to the scientific ideas set out by Captain Gerald Lowry—the blind sportsman, his story of a game struggle, against what to many may seem insuperable obstacles, will be read with lively appreciation. Field-Marshal Viscount Allenby's remarks in the foreword seem to sum up the work sufficiently. He says, "The book deserves to be widely read and thoughtfully studied. . . . Captain Lowry has found the key to health and happiness, he has unlocked the doors, and has thrown them open that all may enter."

Captain Gerald Lowry, late of the Royal Irish Rifles, was, we learn, not only the first British officer but actually the first soldier to be blinded as a result of wounds received on active service in France. This happened in 1914, after the famous retreat from Mons. Deprived of his sight he resolved to develop other senses to their fullest extent, so that by his example he might encourage others similarly incapacitated.

He has always been an open-air man, and it was a great joy when he found himself able to indulge in his pre-war activities. His first attempt was with swimming. At the start, that exercise proved a joyous relaxation from the strain consequent upon the shock of his wounds. Soon the possession of a sixth sense, which he designates "a sense of atmospheric pressure," enabled him to gauge with accuracy the proximity of the ends or sides of a swimming bath before reaching them. Such remarkable progress did he make that he subsequently won the Bath Club fifty yards swimming handicap two years in succession against sighted competitors.

As his strength returned, he extended his field of physical pursuits. Attaining proficiency with the punch ball, which he had never previously encountered, he took up boxing. In December, 1926, he made his public debut in the ring at Brighton,

when he gave a sparring exhibition in aid of the Royal Sussex Hospital. In May, 1927, he crossed over to Paris and gave an exhibition bout at the Sporting Club de France with his trainer, Sergeant Begley, instructor at St. Paul's School, and late of the R.I.C., on behalf of the Société de Phare—the "Saint Dunstan's" of France. At the same time the author took up running, not only on the cinder track but also with the Worcester Park (Surrey) Beagles, and his story here reveals not only his courage, but also a sense of boyish humour which brings back memories of our school days.

Captain Lowry writes of the way in which he keeps physically and mentally fit, and he deals in an interesting manner with the late Dr. A. T. Still's theory concerning the necessity of perfect adjustment of the structures of the body, so that all the parts are kept in their correct alignment, thus enabling an ideal balance to be maintained. He also demonstrates the need for scientific relaxation of the brain and nervous system in these days of speed and high pressure.

This is indeed a book to read, for it tends to give us a truer sense of proportion in many ways, especially when there is a tendency to rail against Fate. To the man against the wall it is a great tonic.

H. H.

Agricultural Economics in the Empire. (H.M. Stationery Office. 6d.).

Reference was made in these columns recently to the growth of British colonial agriculture, in which the volume of trade has trebled since 1906, but it is surprising to learn from this new report that for most countries such statistics are entirely wanting. The Empire Marketing Board has therefore advanced a project for a world agriculture census to be taken in 1930. According to the International Institute of Agriculture, of a total of nearly two hundred countries, including colonies, only thirty-seven have taken an agricultural census in the first twenty-five years of the present century. The area of these countries represents a little less than half the land area and about thirty per cent of the population of the world. The remaining one hundred and sixty countries, representing seventy per cent of the total population, have never taken an agricultural census, or at least not within the last twenty years. The expression "census" refers, of course, to a complete enumeration, for some of the countries already issue annual estimates of acreage under crops. Statistics are seldom the "magic numbers" which they are sometimes supposed to be, but obviously the uncertainty in estimating the world supply of agricultural products is at present unnecessarily great.

Tarka the Otter. By HENRY WILLIAMSON. (Putnam).

The latest award of the Hawthornden prize is to Mr. Williamson for this remarkable work. The prize is given annually for the finest piece of imaginative writing of the year, the judges being Mr. Robert Lynd, Mr. Edward Marsh, Miss Warrender, Mr. Laurence Binyon, and Mr. J. C. Squire. In presenting the prize, Mr. John Galsworthy described "Tarka the Otter" as a truly remarkable creation; it was the result of stupendous imaginative concentration, fortified by endlessly patient and loving observation of Nature, and in his opinion Mr. Henry Williamson was the most intimate living interpreter of wild life. The author has come to the conclusion that animals are incapable of mean actions as we know them. Their instincts are uncorrupted—they are the servants of their species. The idea that animals are "lower" than man fills him with scorn.

Sussex
gave an
trainer,
e of the
" Saint
took up
orcester
only his
gs back

ysically
manner
ssity of
all the
an ideal
eed for
n these

a truer
ere is a
he wall

I. H.

tionery

to the
ume of
rn from
entirely
dvanced
n 1930.
e, of a
es, only
he first
f these
d about
naining
er cent
census,
pression
on, for
acreage
mbers "
sly the
cultural

to Mr.
s given
he year,
h, Miss
ire. In
' Tarka
e result
ndlessly
opinion
erpreter
animals
nstincts
s. The
scorn.